1992 Annual Report of the Adaptive COASTAL OREGON PRODUCTIVITY ENHANCEMENT Program

October 1, 1991 - September 30, 1992

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THE COASTAL OREGON PRODUCTIVITY ENHANCEMENT (COPE) PROGRAM

Initiated in 1987, the Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative effort between the College of Forestry at Oregon State University (OSU), the USDA Forest Service Pacific Northwest Research Station (PNW), the USDI Bureau of Land Management (BLM), other federal and state agencies, forest industry, county governments, and the Oregon Small Woodlands Association. The intent of the program is to provide resource managers and the public with information on management of fish, timber, water, wildlife, and other resources of the Oregon Coast Range. To find effective ways to manage these diverse resources collectively, the COPE Program integrates research, education, and scientific disciplines.

The COPE Program has two related components; scientists in both Fundamental COPE and Adaptive COPE focus on problems related to riparian zone management and the regeneration of Oregon Coast Range forests. Fundamental COPE scientists, mainly from OSU and PNW in Corvallis, conduct basic research studies. Adaptive COPE is an interdisciplinary team of OSU College of Forestry scientists who are responsible for applying and adapting existing research to Oregon Coast Range conditions. Stationed in Newport at the Hatfield Marine Science Center, the Adaptive COPE team is also responsible for facilitating information transfer by providing continuing education opportunities. Adaptive COPE scientists work with county Forestry Extension agents to extend the program throughout the 13-county area of the Oregon Coast Range. Basic research under Fundamental COPE is supported by the USDA Forest Service and USDI Bureau of Land Management. The Adaptive COPE Program is funded by over 32 different organizations, including federal and state agencies, forest industries, and coastal counties.

COPE ORGANIZATION

Advisory Council
Representatives of COPE Cooperators
Provides advice and guidance on program direction
(listing on inside back cover)

Dean, College of Forestry
George Brown
Convenes Advisory Council
Makes major decisions on OSU support

Director, PNW Station
Charles Philpot
Makes major decisions on PNW support

COPE Program Manager
Stephen Hobbs

Coordinates activities of all organizations involved and provides overall program leadership and administration

Adaptive COPE
OSU College of Forestry scientists

Conducts adaptive research and facilitates transfer of information

Fundamental COPE
OSU and PNW scientists

Conducts basic research

Adaptive COPE Staff

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Forest Science
Wildlife: John P. Hayes
Silviculture: Gabriel Tucker

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Federal Agencies

Bureau of Indian Affairs
Bureau of Land Management
Pacific Northwest Research Station
Siskiyou National Forest
Siuslaw National Forest
U.S. Fish and Wildlife Service

State Agencies

Department of Fish and Wildlife
Department of Forestry
Oregon State University

Oregon Counties

Benton
Coos
Curry
Douglas
Polk
Washington

Forest Industries

Boise Cascade Corporation
Georgia-Pacific Corporation
Giustina Land & Timber Company
Hydraulic & Machine Services, Incorporated
Longview Fibre Company
Menasha Corporation
Papé Brothers, Incorporated
Rosboro Lumber Company
Roseburg Resources Company
RSG Forest Products, Incorporated
Smurfit Newsprint Corporation
Starker Forests, Incorporated
Stimson Lumber Company
Weyerhaeuser Company
Willamette Industries, Incorporated
Willamina Lumber Company

Other

Oregon Small Woodlands Association

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HIGHLIGHTS FOR FISCAL YEAR 1992

During its fifth year of research and education activities, Adaptive COPE:

- Initiated three studies: 1) the response of cutthroat trout to timber harvest, 2) the response of fish and wildlife communities to manipulation of riparian zones undertaken to encourage conifer establishment there, and 3) the possibilities for increasing structural diversity in young Douglas-fir stands through commercial thinning.

- Continued nine projects on slope stability, wildlife, riparian silviculture, stream-borne woody debris, and reforestation.

- Published technical articles on research in the Alsea watershed and riparian silviculture, and produced a 48-page bibliography of COPE research and publications from 1987 to 1991.

- Published four issues of the *COPE Report* quarterly newsletter highlighting COPE Fundamental and Adaptive research and technology transfer activities; newsletters were distributed to over 2,000 readers.

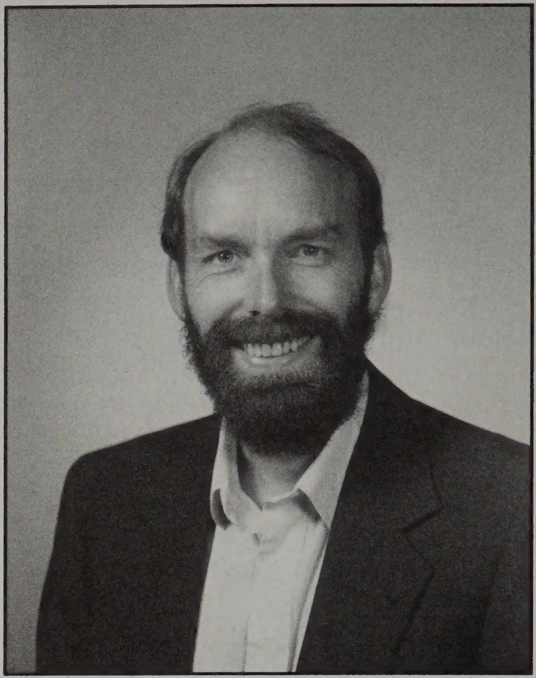
- Co-sponsored a major workshop titled Design and Maintenance of Forest Road Drainage (110 participants) and co-sponsored several other workshops on such topics as monitoring of riparian zones, classification and protection of streams, forest road construction, and slope stability.

- Gave many formal and informal presentations to a wide variety of audiences, including the Northwest Forestry Association, members of the Oregon Society of American Foresters, small-woodland owners, volunteers at the Hatfield Marine Science Center, and a delegation of Thai scientists.

- Displayed a poster on the COPE Program at the Society of American Foresters national convention in San Francisco, and another on restoration ecology of coastal riparian areas at the Ecological Society of America convention in Honolulu.

- Continued to exchange information about the COPE Program with cooperators and coastal citizens through field tours, office visits, and consultation.

NEW WILDLIFE SCIENTIST AT ADAPTIVE COPE



John P. Hayes (Ph.D., Wildlife Ecology) has joined the Adaptive COPE team. He and his family moved May 18th to the Alsea River area near Waldport.

John comes to us from the department of zoology at the University of Tennessee in Knoxville, where he held a post-doctoral fellowship. John received his doctorate in ecology and evolutionary biology from Cornell University in 1990. There, his research dealt with the biogeography, systematics, and conservation of woodrats in the eastern United States.

Before moving to New York, John received his master's in biology at Southern Oregon State College in 1983, and a bachelor's in wildlife science at Oregon State University in 1978.

John has held a number of positions working with wildlife and fish for the Bureau of Land Management and the Forest Service in Oregon and Wyoming.

His publications include popular articles on sea otter, giraffes, hummingbirds, condors, and bears. His scientific publications encompass the ecology of small mammals in the Pacific Northwest, genetics, morphometrics, conservation biology, and biostatistics.

Adaptive COPE welcomes John back to the Pacific Northwest and is pleased to have him on the COPE team.

INTRODUCTION

In 1986, when the COPE program began, its objective was to help enhance the productivity of the Oregon Coast Range by providing information for managing the forests and streams of the Oregon Coast Range to provide the best mix of resource values. The salient resource issues at that time included withdrawal of federal lands from the timber base, declining fish runs, increasing public concern for nongame wildlife, and controversy over Oregon's new forest practice regulations.

During the last 6 years, many of the specific issues have changed—for example, the emergence of the northern spotted owl and biodiversity concerns at the landscape and regional levels. Nevertheless, many of the issues listed above are still very salient. The Oregon Coast Range remains a microcosm of the whole Pacific Northwest as forest managers continue to deal with withdrawal of federal land from the timber base resulting from the listing of the northern spotted owl, and declining fish runs resulting in individual runs and populations of fish being listed or considered for listing as threatened or endangered. Finally, the Oregon Department of Forestry, in response to legislation, continues to rewrite the forest practice regulations, including clearcut size limitations, "green-up" standards, new standards for leaving wildlife trees, and, as this report goes to press, the new stream classification and riparian-zone management rules are being considered by the Board of Forestry.

Clearly, at this time, the need for new information and the need for a more effective exchange of information among researchers, managers, and the public are as important as ever before. The COPE program was organized to seek out approaches that would allow for simultaneous, integrated management of multiple resources. The COPE approach includes an integrated research program accompanied by an integrated education and information sharing program. The wide mix of COPE cooperators and their continued strong support demonstrates that the COPE program continues to fill a needed role in the ever-changing field of forest resource management in the Oregon Coast Range.

COPE consists of two components:

- Fundamental COPE, which conducts basic research from the OSU and USDA Forest Service research labs in Corvallis, and
- Adaptive COPE, which conducts applied studies and technology transfer from its base at OSU's Hatfield Marine Science Center at Newport. The Adaptive COPE team is composed of scientists in hydrology, wildlife, and silviculture who work together to produce forest management technologies that are research-based and interdisciplinary.

In this fifth year of Adaptive COPE, our research and education programs have covered a broad range of subjects, including slope stability, wildlife habitat, alternative silviculture, large stream-borne woody debris, and reforestation. This report summarizes our activities and accomplishments during FY 1992.

The funding for Adaptive COPE comes from a diverse array of cooperators, including private industry; federal and state agencies, county governments; and non-industrial woodland owners. This diversity makes for a strong commitment to developing objective, well-researched information for multiple-use land management in the Oregon Coast Range.

RESEARCH

SLOPE STABILITY

MODELING ROOT REINFORCEMENT IN SHALLOW FOREST SOILS

(Arne Skaugset—Adaptive COPE; Marvin Pyles—OSU Department of Forest Engineering)

Landslides are common in the Oregon Coast Range because of the combination of steep slopes, shallow soils, and prolonged and intense winter rainfall. Historically, road-related landslides have been the dominant source of management-caused erosion. As road construction and maintenance practices have improved, however, road-related landslides have diminished in importance, and the emphasis has shifted to landslides elsewhere in harvest units.

In-unit landslides result, in theory, when the roots of harvested trees decay, reducing soil reinforcement and thus soil strength. The goal of this research is to develop a model to predict the increase in soil strength attributable to root reinforcement. Such a model would make it possible to determine the contribution of root reinforcement to soil strength in alternative silvicultural treatments. The objectives of this project are 1) to develop a process-based, mechanistic model of root reinforcement in shallow forest soils, and 2) to test the model under controlled conditions.

We are now completing the fourth year of this project. During the first two years we made progress toward developing both the analytical model and the physical model that will be used to test it. The conceptual development of the analytical model was reported in a *COPE Report* article (2(2):4-7). In subsequent years, we developed and reported on the physical model, or "tilting table," and part of its data acquisition system (*COPE Report* 3(1):2-4).

Progress on the model is continuing, although it has been slowed by the realignment of priorities within the Adaptive COPE program. Recently, the theoretical development of two important soil parameters, the p-y curves and shear-stress transfer at the soil-root interface, has been completed and can be incorporated into the analytical model. This model should be completed in this fiscal year, allowing for a parameter study in which the increase in soil strength attributable to root reinforcement will be modeled over a range of root reinforcing properties and strengths and densities of soil. A manuscript will be prepared shortly thereafter.

This project will help increase our understanding of how roots reinforce shallow forest soils and should therefore be valuable for managing landslide-prone terrain. The model could also be valuable in examining the influence of vegetation type and density on stability of high-risk sites and in assessing the effects of alternative silvicultural practices on soil strength. Present slope-stability models that require information on root reinforcement could also be improved by incorporating information from this model.

ASSESSING THE STABILITY OF END-HAUL DISPOSAL AREAS

(Arne Skaugset—Adaptive COPE; Marvin Pyles—OSU Department of Forest Engineering; Dave Michael, Keith Mills, and John Seward—Oregon Department of Forestry)

End-hauling is the practice of loading and hauling road construction spoil from steep terrain to more stable locations. End-hauling was developed as a more stable alternative to sidecasting, the traditional method of disposing of such material. However, locating sufficiently flat and stable end-haul disposal sites is a significant problem in the steep, highly dissected terrain of the Coast Range. Recent experience has shown that even relatively flat, apparently stable terrain can fail when spoil material is placed on it. The failure rate for end-haul disposal areas is small, but the consequences of failure can be significant. Because this problem has never been investigated rigorously, there are no formal criteria for selecting end-haul disposal sites.

The objective of this project is to investigate current methods of assessing the stability of end-haul disposal areas. We will develop an inventory of large (volume > 10,000 cubic yards) end-haul disposal sites throughout the Coast Range, both stable and failed. After surveying each site, we will develop a conceptual model of the geology and geomorphology of the sites. Failed areas will be analyzed to determine limiting strength values of the soil and rock. These values will be used in analyzing the stable disposal sites and other potential disposal areas in similar terrain. Analysis will include several different slope-stability models and analysis techniques. The results will help forest engineers choose the most appropriate slope stability model, analysis technique, and material parameters to assess the stability of potential end-haul disposal areas.

Adaptive COPE will support a Forest Engineering graduate student to carry out this research as a part of his or her degree program. The project will be completed within 2 years, with manuscript preparation and publication scheduled for the third year.

WILDLIFE ABUNDANCE AND DIVERSITY IN MANAGED UPLAND FOREST LANDSCAPES

(Andrew Hansen, Pei-fen Lee, Eric Horvath—Adaptive COPE)

With the emergence of biological diversity as a mainstream issue on public lands in the Pacific Northwest, there is much interest in finding ways to optimize both wood production and conservation of wildlife diversity. By enriching habitat complexity in managed plantations, managers hope to retain native wildlife diversity; silvicultural approaches that maintain live canopy trees, snags, shrubs, fallen trees, and other habitat features are being widely advocated. Relatively few studies in the Oregon Coast Range, however, have compared habitat patterns and wildlife diversity between natural forests and managed plantations. Thus, little is known about the species that might be sensitive to timber management or about the habitat features required by these species.

At the landscape level, silvicultural practices can influence habitat patterns, including the size and edge characteristics of forest stands. Widespread concern over the fragmentation of natural forests and loss of species that require large forest stands has resulted in cutting patterns designed to maintain large stands. In the Northwest, however, little information is available on animal species that might specialize on forest interior habitats and might therefore be sensitive to forest fragmentation.

This project examines forest structure, vertebrate communities, and edge effects in managed and natural forests in the Oregon Coast Range. The objectives are to: 1) describe within-stand forest structure in clearcuts (2-8 years), closed-canopy plantations (25-30 years), and mature forest (90-140 years); (2) quantify associations between vegetation and wildlife within these forest types at the microhabitat and stand levels; and (3) determine the distributions of vertebrate abundance along the borders between natural mature forests and both clearcuts and closed-canopy plantation. Three study sites were established for each of these two edge types. At each site, three parallel transects were placed perpendicular to the edges, each extending 260 meters into the plantation and 400 meters into the mature forest. Vegetation structure and composition were recorded and animal abundance was sampled by sight and sound (birds) and trapping (small mammals and amphibians) at 20-meter intervals along the transects.

Preliminary results from the first year of the 3-year study were reported in *COPE Report* 3(2):3-4. In summary, species diversity of birds, small mammals, and amphibians was highest in clearcut plantations, intermediate in natural mature forests, and lowest in closed-canopy

plantations. Total abundances of birds and amphibians were, respectively, 50 and 130 percent higher in natural forest than in closed-canopy plantations. Eleven percent of bird species were more abundant in natural mature forest interior than near the forest edge, and 22 percent had higher densities in clearcuts than at plantation edges. No species was strongly associated with the edges. Total bird density was considerably higher in forest and clearcut interiors than at the stand edges.

Data on bird response to forest edges from the second year corroborated those of the first year. Data from the combined years showed that some species were associated with either clearcuts or forest interiors (Figure 1). Total bird abundance was especially low at edges between mature forest and clearcuts (Figure 2). The final year of field sampling is now completed. All data have been prepared for analysis, and final analyses are underway.

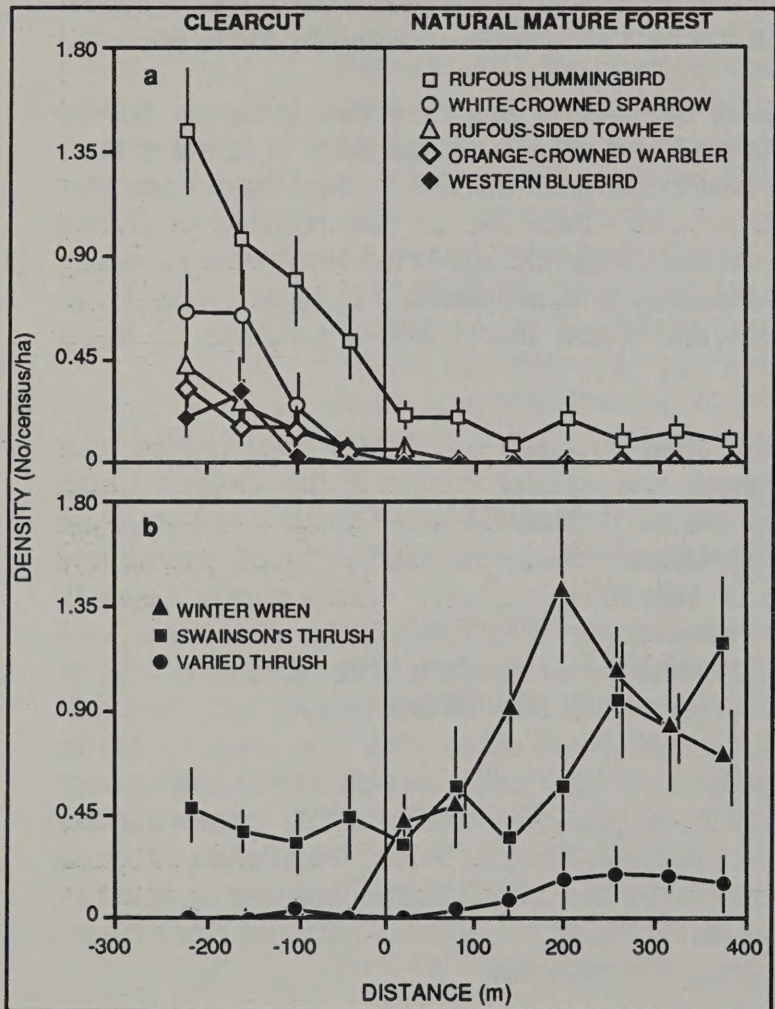
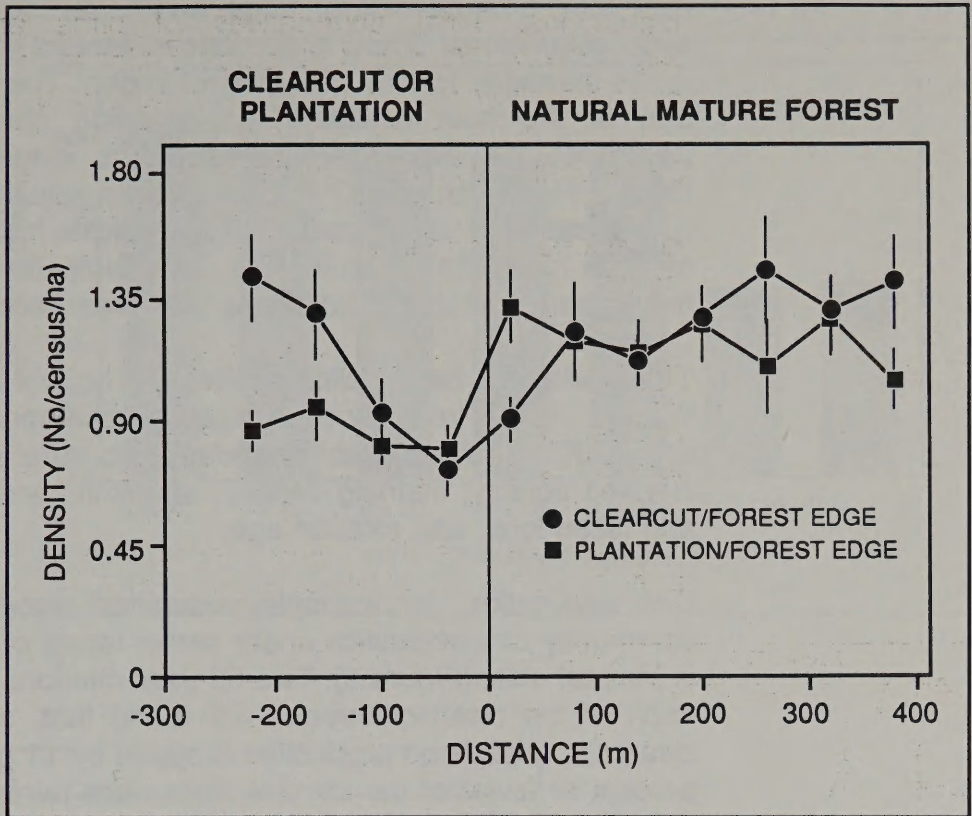


Figure 1. Bird species significantly associated with a) clearcut interior or b) forest interior habitats. Data points are averages (and standard errors) for 80-m sections along transects at three sites in the central Oregon Coast Range.

Figure 2. *Total bird abundance (all species sampled) along two types of forest edge transect: clearcut/mature forest edge and closed-canopy plantation/mature forest edge. Data points are averages (and standard errors) for 80-m sections along transects at six sites in the central Oregon Coast Range.*



When complete, the study should provide a more complete picture of species that are sensitive to forest management practices and the habitat features these species require. This information will aid in the development of management strategies that optimize both species conservation and wood production.

This study was described in the *Northwest Environmental Journal* (6:418-419). The first-year results were briefly summarized in an article comparing natural and managed forests (*BioScience* 41(6):382-392). The data were also used to calibrate a landscape simulation model reported in a book on ecotones. The results were reported widely at numerous continuing education events.

ADAPTATION OF A FOREST SUCCESSION AND WILDLIFE MODEL TO A MANAGED COAST RANGE FOREST

(Andrew Hansen, Steve Garman, and Barbara Marks—OSU Forest Science Department)

Land managers are increasingly interested in information on how multiple resources are likely to respond to alternative management strategies. Simulation models are useful for making such projections

over long time periods or large areas. We have adapted the forest succession model ZELIG to simulate forest and wildlife habitat dynamics in the managed forests of western Oregon. This modeling approach is one of the best available for modeling stands that range from single-species, even-aged plantations to long-rotation, uneven-aged forests. Moreover, ZELIG outputs data on simulated forests that allows quantification of wood production and wildlife habitats. Thus, the model can be used to quantify the long-term tradeoffs under various management strategies for these two forest resources.

The model has been validated for both natural and managed forests. We are using it to perform simulation experiments on wood production and wildlife habitat suitability under silvicultural prescriptions involving planting density; thinning density; retention levels of live trees, snags, and fallen logs; and rotation age.

One application, for example, examined wood production and bird community characteristics under seven levels of canopy tree retention in harvest units (Figure 3). Two 80-year rotations were simulated under each of the retention levels. We found that, compared with that in clearcuts, total wood production dropped by 11 percent or less when 8 percent or fewer of the canopy trees were retained (Figure 4). Higher levels of retention were associated with much higher loss of wood production. Simulated bird diversity generally increased with canopy tree retention level (Figure 5).

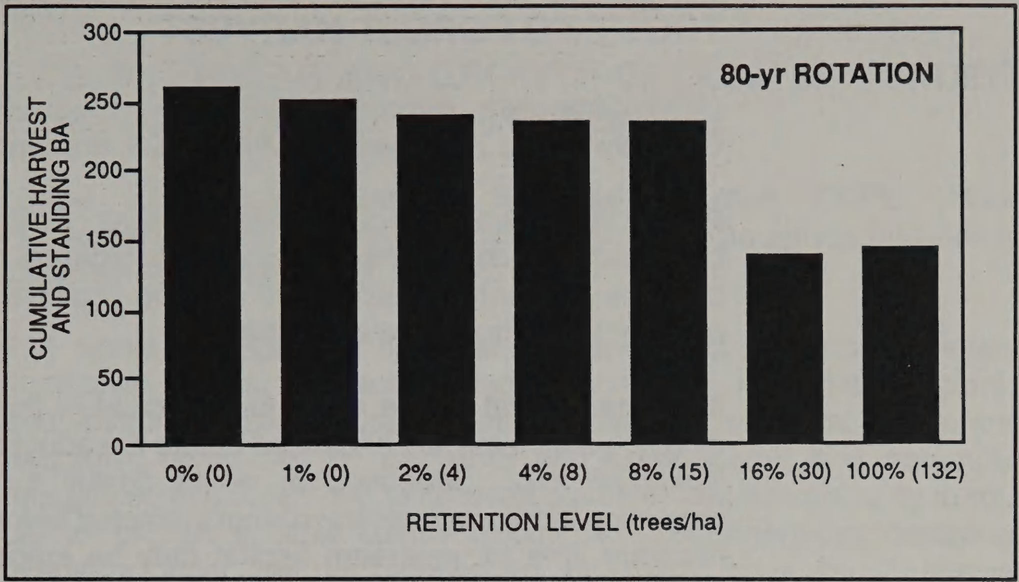
These results are useful for identifying thresholds where wood production and bird habitat objectives are balanced. The experiment suggested that retaining 8 percent of the canopy trees would maintain relatively high bird diversity while reducing wood production by only 11 percent. Such information can help managers choose the management strategies that best accomplish their objectives.

SIMULATION SCENARIOS

Site: . . . . Elevation 900m
Initial Conditions: . . . . 250-yr-old natural stand
Harvest System: . . . . . Clearcut with retention of trees > 30 cm DBH
Regeneration: . . . . Plant 988 Douglas-fir/ha, thin yr 15 and yr 30
Retention (trees/ha): . . . . 2 levels (80 yrs for 2 rotations, 160 yrs for 1 rotation)

Figure 3. Simulation experiment conducted using the forest succession model ZELIG.

Figure 4. Simulated wood production (cumulative basal area harvested plus standing basal area at year 160) over two 80-year rotations under different levels of canopy tree retention. (Number of trees retained per hectare under each retention percentage.)



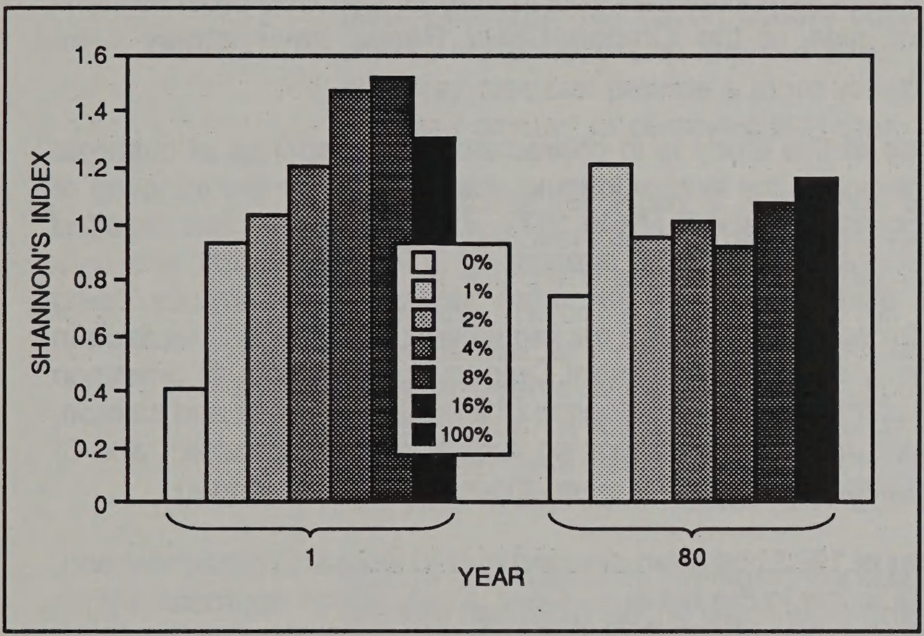


Figure 5. Simulated bird habitat diversity at years 1 (following harvest) and 80 (end of first rotation) under several levels of canopy tree retention.

LONG-TERM RESPONSE OF RESIDENT CUTTHROAT TROUT TO FOREST HARVEST

(Arne Skaugset—Adaptive COPE; James D. Hall and Patrick J. Connolly—OSU Fisheries and Wildlife Department)

Few studies have been conducted on coastal cutthroat trout in streams bordered by second-growth forest stands older than 25 years. Efforts to describe long-term response to logging promise to be important in making sound management decisions.

Most forests that will be ready for a second or third harvest within the next 30 years were last harvested before the adoption of Forest Practice Rules in 1972. Streams that would qualify for maximum riparian protection today were commonly not protected before then. Because the recovery time for in-stream habitat may be longer than the planned rotation period for forest harvest, assessment of the fish population in a second-growth drainage targeted for logging may not be indicative of the pre-disturbance level of fish production. In addition, resident populations of coastal cutthroat trout in first- and second-order streams of the west side of the Oregon Coast Range have largely been overlooked.

The purpose of this study is to characterize the response of cutthroat trout populations to the kind of logging practiced before the adoption of Oregon's Forest Practice Rules in 1972. Progress to date has included selection and sampling of 12 streams for intensive habitat and fish-population assessment. Several more streams are currently being evaluated for sampling. Criteria for site selection include: 1) location in a west-side drainage of the central Oregon Coast Range, 2) presence of resident cutthroat trout, 3) absence of anadromous trout and salmon, 4) a relatively homogeneous logging history of the watershed, and 5) absence of streamside buffers when the area was last logged.

The summer of 1992 has been devoted to field work and data collection. Analysis will follow in the fall and winter. A regression approach will be taken to depict response of cutthroat trout populations in terms of biomass per area over the time since the watershed was logged. Stream habitat conditions will be analyzed similarly.

Subsequently, the current Forest Practice Rules will be evaluated to determine their effectiveness in protecting cutthroat populations when second-growth stands are logged. The study will also evaluate how and when coastal cutthroat trout use headwater streams.

ESTABLISHMENT AND GROWTH OF CONIFERS UNDER EXISTING RIPARIAN VEGETATION

(Gabe Tucker and Barbara Schrader—Adaptive COPE; Mike Newton—OSU Forest Science Department; Mike Cloughesy and Ralph Duddles—OSU Extension Service)

The active management of forest riparian zones is a topic of ever-increasing interest to forest managers, scientists, regulators, anglers, and environmentalists. Riparian areas in the Oregon Coast Range are frequently dominated by red alder and salmonberry. It is generally recognized that alder, due to its small diameter and susceptibility to rot, cannot provide suitable coarse woody debris. Furthermore, decaying overstory alder will be succeeded on many sites by a simple salmonberry climax, precluding establishment of any tree species.

Underplanting with conifers can alter these alder-dominated stands to favor overstory tree cover. Mature conifers provide a better source of coarse woody debris to improve stream morphology and fish habitat, and they also can provide a more varied stand structure and, perhaps, a limited amount of commercial timber.

The object of this study is to determine which combination of conifer species and overstory and understory vegetation control treatments are best for establishing conifers under alder. Beginning in 1989, six alder-dominated research sites along the Oregon Coast Range were underplanted with four conifer species. A range of overstory and understory removal treatments was applied, and half the seedlings were protected from animal damage by a cover of flexible plastic tubing. The plantations have been monitored at least twice yearly for over 2 years; first-year results were published in *COPE Report* 4(2):2-4.

Across all treatments, western redcedar had the highest survival and western hemlock had the best height growth. With partial or no overstory removal, all species except redcedar had higher survival when the understory vegetation was also controlled. When the overstory was completely removed, Douglas-fir in particular seemed to benefit from brush control. These and other preliminary results will be released soon. The project is scheduled to continue through 1996.

INTEGRATED RESPONSE OF MULTIPLE FOREST RESOURCES TO ACTIVE MANAGEMENT IN RIPARIAN ZONES

(Arne Skaugset, Gabe Tucker, and John Hayes—Adaptive COPE; Loren Kellogg—OSU Forest Engineering Department)

Because riparian-zone management is one of the most important issues identified by COPE cooperators, a considerable amount of COPE research during the past 5 years has been dedicated to this subject. This research includes, among other topics, the ecology of riparian-zone vegetation, fish habitat and riparian-zone interactions, wildlife habitat in riparian zones, and the silviculture of riparian-zone vegetation. This research has had two general thrusts: 1) investigating the structure needed in riparian areas to provide the diversity of functions associated with riparian zones, and 2) finding vegetation management strategies within riparian zones to maintain or enhance that structure.

Exemplifying this research are the COPE studies of interactions between riparian-zone vegetation, woody debris in streams, and fish. Current COPE fisheries research has confirmed other research over the last 2 decades in finding that the health, productivity, and diversity of fisheries in forest streams depend directly on the amount of large woody debris in those streams. Furthermore, debris from conifers has been shown to be more desirable than that from hardwoods, from a fisheries point of view. Current COPE research also shows that the character of woody debris in streams—its amount, size, and species—is a function of streamside management history and the current condition of the riparian zone. Because the riparian area is a primary source of large wood for streams, large conifers must be present there in order to supply streams with an adequate, long-term supply of large woody debris and, hence, healthy fish populations over the long term.

COPE research also shows that the Oregon Coast Range has many stands regenerated after harvest in which the riparian areas are structurally and functionally much different from those in naturally regenerated stands. In general, the streams that drain these second-growth stands are debris-poor and the riparian areas are structurally poor, dominated by a red alder overstory with an understory of salmonberry, vine maple, and sword fern. The character of this vegetation precludes recruitment of large-conifer woody debris from the riparian zone; furthermore, current practices emphasizing management exclusion in riparian areas could exacerbate the problem by encouraging the development of understory brush thickets. This is a lose-lose situation for all riparian-zone functions.

Research to provide answers to this management problem has progressed on two fronts: stream enhancement and riparian silviculture. Debris-poor streams can be enhanced by adding woody debris;

numerous research projects, including one COPE project, are investigating the effects of different stream-enhancement techniques on aquatic habitat and fish populations. However, stream enhancement doesn't solve the longer-term problem of recruitment of woody debris from riparian zones dominated by hardwoods. Research on riparian silviculture is directed toward developing silvicultural systems to establish conifers and encourage them to grow in hardwood-dominated riparian zones.

To date, COPE research on stream enhancement and riparian silviculture has been carried out in separate studies and installations on the scale of either a stream reach or a plot. An integrated project, new this year, will combine the two avenues of research and expand the effort to an operational scale.

Research will be carried out on three harvest units provided by COPE cooperators. Replicated treatments on stream enhancement and riparian silviculture will be installed during the harvesting of these units. The treatments will include 1) adding woody debris to the stream during harvesting and 2) actively manipulating riparian zones to enhance the establishment and growth of conifer seedlings. These activities will take place using the yarder on site. The logging-engineering portion of both phases of the project will be carried out in collaboration with Loren Kellogg of the OSU Forest Engineering Department as part of his Fundamental COPE research project on harvesting alternatives in upland and riparian areas. Both the in-stream and riparian-area active management treatments will be prescribed by an interdisciplinary team consisting of, at least, a silviculturist, a wildlife biologist, a logging engineer, and a hydrologist.

The goals of this project are 1) to document the operational constraints of both treatments (logging feasibility, human safety issues, logging production, and costs) and 2) to monitor the efficacy of the treatments. This monitoring will include determining the effects of the active riparian-zone manipulation on establishment and growth of seedlings and on riparian wildlife habitat, determining the effects of stream enhancement on aquatic habitat, and looking at the short-term effects of both active manipulation and stream enhancement on water and stream quality.

RELEASE OF SUPPRESSED CONIFERS IN ALDER-DOMINATED RIPARIAN ZONES

(Gabe Tucker, Barbara Schrader, and Steve McConnell—Adaptive COPE; Bill Emmingham—OSU Forest Science Department)

Any forest manager engaged in establishing a conifer overstory in a riparian zone should first assess the stocking of existing conifers. If understory conifers are present, promoting them to a position of stand dominance is faster and cheaper than planting new seedlings. Studies of upslope advance regeneration have shown that even highly suppressed trees can respond to release. Moisture stress is less of a problem in the riparian zone, but competing vegetation is often more aggressive. Shade tolerance may be more important than the ability to compete for water in shaded riparian environments.

This project was begun in an attempt to develop methods for releasing understory conifers, and also to define parameters to better predict the likelihood that a given tree would successfully respond to these methods. Six alder-dominated riparian research sites (different from those used in the underplanting study) were established representing a range of different species and sizes of conifers in the existing understory communities. Study trees include Douglas-fir, the most abundant, followed by western hemlock, Sitka spruce, and western redcedar. Trees ranged in size from less than 1 to 20 meters in height; most were under 6 meters.

The treatments included felling and girdling of surrounding trees and leaving an untreated control. It is far too early to report any conclusive results, but preliminary results show that so far the trees that have died have been mostly Douglas-fir (13 percent), and all Douglas-fir mortality has been due to competing vegetation. The mortality rate of western hemlock has so far been half that of Douglas-fir, but over half this mortality was caused by rodent damage. Percent mortality for both Sitka spruce and western redcedar has been less than 3 percent. This project is scheduled to continue through 1996.

INFLUENCE OF WOODY DEBRIS PIECE SIZE AND ORIENTATION ON FUNCTION IN SMALL STREAMS

(Arne Skaugset—Adaptive COPE; Bob Bilby—Weyerhaeuser Co.; Jim Sedell—USDA Pacific Northwest Research Station)

Understanding of the role that large woody debris plays in forest streams has increased significantly over the last 2 decades. Notably, research has shown that large woody debris improves fish habitat by increasing pool types and sizes, sediment storage, and local scour. However, simply knowing that "wood is good" is insufficient for making site-specific prescriptions that include the number and size of woody debris pieces required to maintain adequate aquatic habitat. The goal of this project is to help provide this information for Coast Range headwater streams by investigating the effects of the size and orientation of large woody debris pieces on debris stability, stream channel morphology, and aquatic habitat.

Woody debris of three different sizes—8, 16, and 24 inches in diameter—were placed in two coastal headwater streams at two different orientations: "spanners" were placed perpendicular to streamflow and resting on the bottom of the channel, and "ramps" were oriented downstream at approximately 45 degrees to streamflow. Thirty-six debris pieces were installed during the summer of 1989.

Data collection has consisted of inventories of aquatic habitat and fish population and stadia traverses of stream channels. A stadia traverse is used to generate a topographic map of the channel so that changes in channel morphology, such as local scour and fill, can be calculated. Aquatic habitat inventories are carried out by identifying stream reaches as pools, glides, or riffles and measuring their width, length, and depth. A census of fish populations is taken by electro-shocking. All data were collected in the summer of 1989, before the debris pieces were installed, and were repeated during the summers of each of the next 2 years.

Habitat inventories showed that the diversity of aquatic habitat increased with the addition of woody debris; both the number and types of aquatic habitat units increased per unit of stream length. In general, slow-water habitat—pools and glides—were formed at the expense of fast-water habitat, or riffles (Figure 6). Changes in the aquatic habitat were caused by the debris' altering of channel hydraulics, which caused lateral scour pools or plunge pools to develop. Table 1 shows pool volumes associated with the different combinations of debris piece size and orientation for one stream, J-Line Creek. The table shows that the larger "spanners" are the most effective in size and orientation for influencing local scour and creating pools.

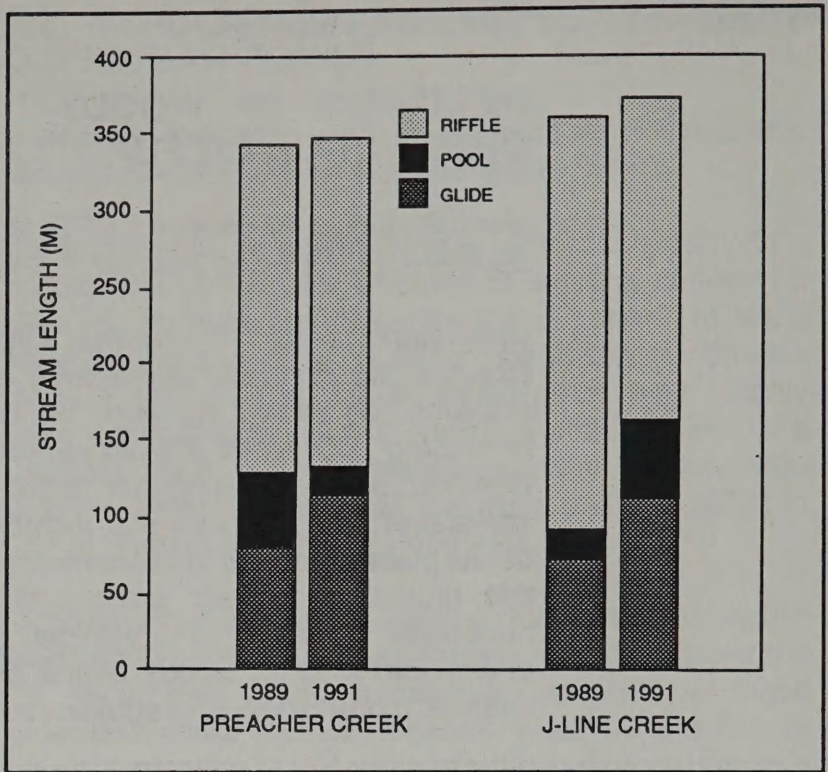


Figure 6. A comparison of the total length of pool, riffle, and glide habitat types for Preacher Creek and J-Line Creek between 1989, before large woody debris was added, and 1991, after the debris had been in place for two winters.

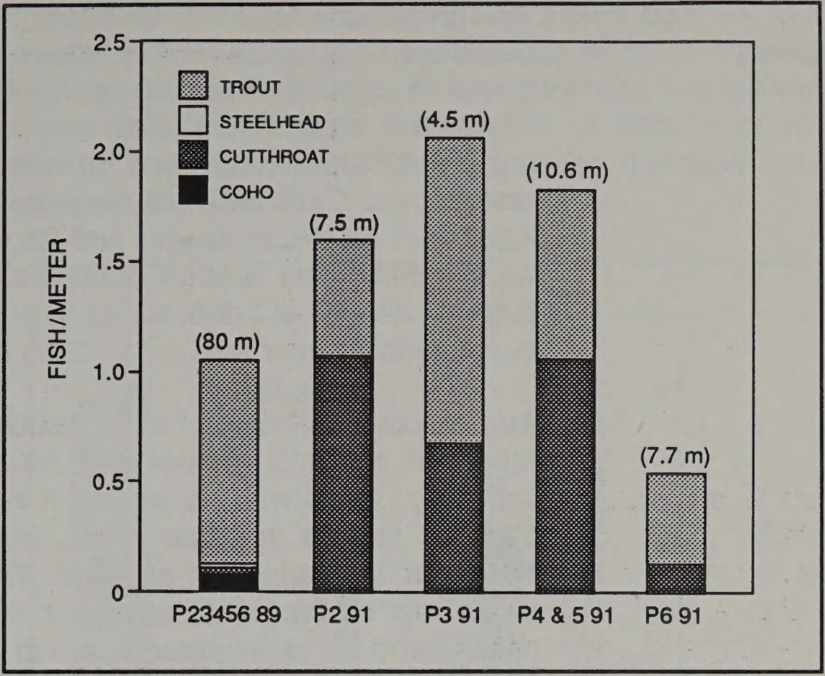
Debris piece orientation	Debris piece diameter (in) 8	16	24
Ramp	-	0.02 (1)	0.09 (1)
Spanner	0.27 (1)	3.38 (2)	1.80 (3)

Table 1. Pool volume (m^3) for the different combinations of debris size and orientation for J-Line Creek during the summer of 1991. (Number of debris pieces creating the accompanying pool volume.)

The debris pieces also affected the presence of fish. Figure 7 shows fish density associated with an 80-meter section of J-Line Creek in which five debris pieces were installed. The figure shows that the overall density of fish present increased after the debris pieces were added.

First-year results for this project were presented in the *COPE Report* 4(2):4-6. Data analysis will continue to refine the relationships between piece size and orientation and channel morphology, aquatic habitat, and fish density. A manuscript on the second-year results is scheduled for the coming fiscal year.

Figure 7. A comparison of fish density for an 80-m section of J-Line Creek in 1989, before debris pieces were added to the stream (P23456 89), and in 1991, after the debris had been in place for two winters (P2 91, P3 91, P4&5 91, P6 91). (Length of the habitat unit sampled for the fish density reported.)



Results from this project should prove helpful for predicting habitat improvement when woody debris is added to streams as part of enhancement projects, and for modeling habitat improvement from natural recruitment of riparian trees to streams. This project will also provide information for writing site-specific prescriptions for riparian areas that will maintain or improve aquatic habitat while allowing a compatible level of timber harvest along coastal streams.

LARGE WOODY DEBRIS AND FISH HABITAT IN COAST RANGE STREAMS

(Arne Skaugset and Ron Rhew—Adaptive COPE; Robert Beschta—OSU Forest Engineering Department; Gordon Reeves and Jim Sedell—USDA Pacific Northwest Research Station)

Awareness of the beneficial role played by large woody debris in salmon and trout habitat has increased substantially over the past 2 decades. As a result, state and federal regulations now require protection for woody debris in fish-bearing streams and retention of standing conifers adjacent to fish-bearing streams after harvesting to provide future large woody debris. Forestry and fisheries management agencies have also initiated programs to add large woody debris to debris-poor streams. However, criteria for determining desired amounts and sizes of debris and for developing and evaluating debris management plans are currently not available.

This project attempts to help fill this information gap by assembling both published and unpublished information on large woody debris in Oregon Coast Range streams into a single, computerized database. This information was collected from inventories of large woody debris carried out by federal, state, and private land managers and university researchers. Data were obtained from 69 streams, encompassing 217 kilometers of stream length and 28,485 pieces of debris. These data were entered into a large database, making it possible to document current levels of debris loading and to examine how debris characteristics vary with parameters of stand and watershed.

As expected, amounts of large woody debris varied greatly across the range of streams represented by the database. Because of this variability, there was no apparent relationship between debris piece count or volume and basin area, order of the stream, number of its first-order tributaries, or gradient. There was a general decrease in numbers of debris pieces as stream width increased (Figure 8); this has been noted by other researchers in streams bordered by old-growth forests. The relationship is attributed to the increased capacity of large streams to carry debris downstream.

A comparison of debris piece data revealed that Coast Range streams, in general, had fewer pieces of debris than old-growth streams in western Washington (Figure 8). This difference is most likely accounted for by management history and successional stage of riparian vegetation of the streams. Streams draining unharvested stands had a higher piece count of woody debris than streams draining second-growth or mixed harvested and unharvested stands (Figure 9), and they averaged more than twice the volume of woody debris.

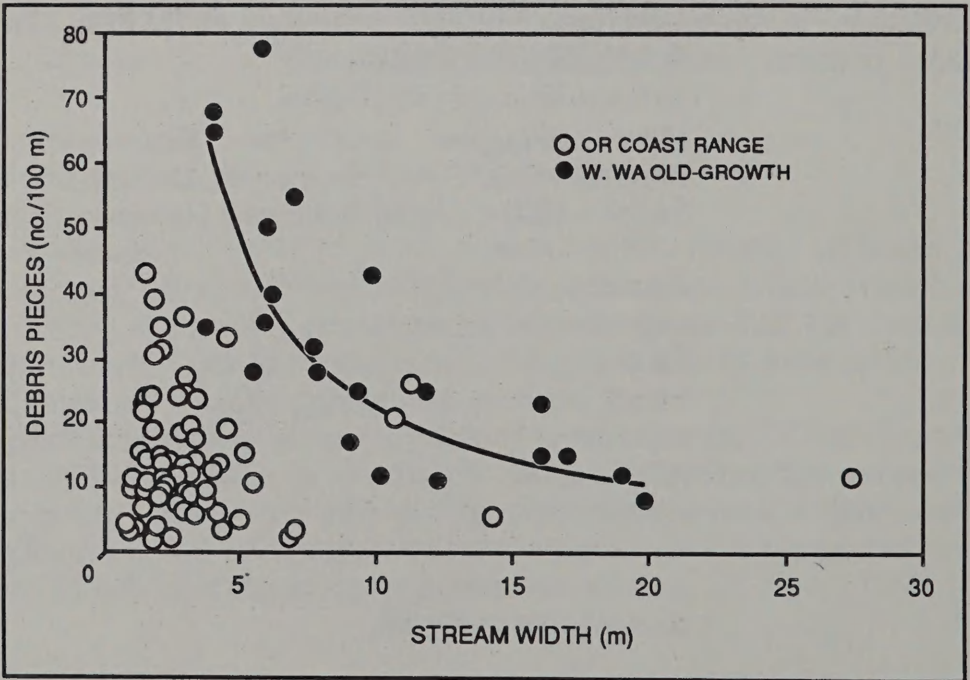
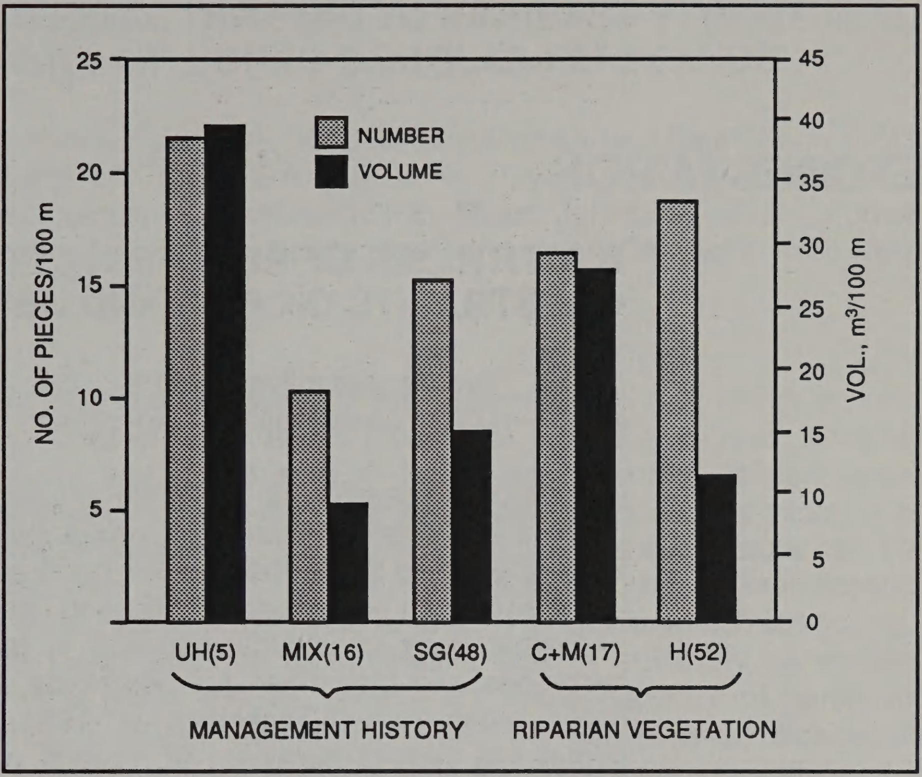


Figure 8. The relationship between number of debris pieces and stream width for Oregon Coast Range streams and for western Washington streams draining old-growth forests.

Streams draining riparian stands of conifers and mixed conifers and hardwoods had similar numbers of debris pieces as streams draining hardwood riparian stands, but they had approximately twice the volume of debris. Hardwood riparian stands are characteristic of second-growth forests that resulted from harvesting before conifer retention was required in riparian zones.

Figure 9. Numbers (per 100 m) and volume (m^3 per 100 m) of large woody debris in streams with varying management history and riparian vegetation characteristics. UH, unharvested; MIX, mix of harvested and unharvested; SG, second growth; C+M, conifer and mixed conifer/hardwood; H, hardwood riparian vegetation. (Number of streams in each category.)



Because this information was developed from diverse studies in which different data collection methods were used, the database has limitations. Our experience in compiling it reinforces the need to develop standardized survey methods for measuring debris. Based on this experience, we recommended that:

1) Large woody debris be defined with common minimum dimensions. Most studies have used 10 cm for a minimum diameter and 1 m for a minimum length.

2) A common system be developed to describe the position of debris in relation to the stream channel, stream bank, and floodplain.

3) Debris surveys depend on actual measurements of debris dimensions, not on visual estimates.

Its limitations notwithstanding, this database is valuable for documenting changes in amounts and sizes of large woody debris over a wide geographic area with a diverse management history. The database provides baseline information useful for developing guidelines for debris

management on a regional as well as a site-specific basis. Debris surveys of these same streams in future decades can provide a check on the effectiveness of our current management practices.

The result of the preliminary analysis of the database was presented in *COPE Report* 4(3):3-5. A draft manuscript is expected during the 1993 fiscal year.

REFORESTATION

A SYNTHESIS OF REFORESTATION PRACTICES WITH CONSTRAINTS ON FIRE AND HERBICIDES

(Gabe Tucker—Adaptive COPE; Bill Emmingham and Steve Hobbs—OSU Forest Science Department)

Competing vegetation is a severe problem in the establishment of conifers and forest regeneration throughout the Oregon Coast Range. Such species as salmonberry in the north and central coast and tanoak in the south can be especially difficult to control. The problem has been exacerbated by constraints imposed in recent years on the use of herbicides and prescribed fire. Herbicide use was curtailed by court order within federal agencies in 1983, and other organizations sometimes restrict spraying for various reasons. Pressures to limit smoke encroachment into populated areas has constrained the use of prescribed burning for brush control and site preparation.

The purpose of this project is to bring together all available information on forest regeneration taking place under constraints on fire and herbicides and synthesize it into a paper, making it easily accessible to land managers throughout the Coast Range. This year an initial draft manuscript was completed and sent out for review to several silviculturists who are dealing with such problems on a daily basis. A half-day meeting was then conducted on the OSU campus to allow the authors and many of the reviewing silviculturists to exchange ideas.

The final draft of the synthesis will be coming out soon. It will emphasize several key elements of establishing seedlings successfully under constraints on the use of herbicides or prescribed fire. They include: 1) cutting brush during the phenological "windows" or time periods when brush species are most susceptible to hand release, 2) using large planting stock of selected genetic makeup, and 3) rapidly treating problem sites before the brush has a chance to gain the upper hand. Within the operational environment of the Coast Range, the single most important factor in devising a successful strategy is an extensive knowledge of the autecology of the competing brush species. The

reproductive habits of these species and their phenological cycles of bud and root growth are of critical importance when the use of fire and herbicides is restricted.

COMMERCIAL THINNING TO INCREASE STRUCTURAL DIVERSITY OF YOUNG DOUGLAS-FIR STANDS

(Gabe Tucker—Adaptive COPE; Bill Emmingham and Sam Chan—OSU Department of Forest Science; John Hayes, Arne Skaugset, and Barbara Schrader—Adaptive COPE; Stuart Johnston—USDA Forest Service, Siuslaw National Forest; Don Minore—USDA Pacific Northwest Research Station)

The structural characteristics of forest stands can vary widely among stands of a given age. Stand basal area, density of trees, species composition, and crown area of trees can be vastly different even though the stands in question may have been established at exactly the same time. Practically all the characteristics of stand structure can be readily modified through silvicultural manipulation, and this modification can be done rapidly if the stand is already established but still young. Because stand structure determines a stand's suitability as wildlife habitat for a given species, silvicultural manipulation is of particular importance in wildlife management and the conservation biology of wildlife species sensitive to changes in stand structural diversity.

This study is the newest silviculture project in Adaptive COPE and is designed to extend through the life of the COPE program, ending in 1998. Its aim is to examine the response of 30-year-old Douglas-fir stands to commercial thinning to varying densities and the subsequent underplanting with a variety of species. All treatments are being done at commercial-thinning age so that the operations will be economically viable.

The first of three sites is scheduled to be harvested during the summer of 1992; two additional sites will be harvested the following summer. Each site will have an area on which 100, 60, and 30 trees per acre will be left, along with an untreated control. Within each of these areas, a growth and yield plot will be established prior to treatment to the specifications of the Stand Management Cooperative, a group that has established protocol for studies like this one.

Stand structure, including leaf area, and growth and yield of merchantable timber will be periodically monitored through the life of the project. The response of the understory vegetation will be of great importance from the perspective of both wildlife habitat and the

PNW Station are collaborating on this part of the study. The influence of changes in forest structure that result from the experimental treatments will be monitored to assess their influence on wildlife habitat. Due to the small size of the study areas, these assessments will, of necessity, be qualitative rather than quantitative. The wildlife habitat assessment will rely heavily on results from other COPE studies, including projects that have been completed, are in progress, and are planned for the coming years.

EDUCATION

To ensure that research information developed by COPE is quickly available to a broad audience, Adaptive COPE scientists publish scientific papers, reports, and a quarterly newsletter; organize workshops; make formal presentations, lead field tours, and consult with cooperators. Forestry Extension agents help in bringing COPE research findings and activities to the attention of the general public via their county Extension newsletters and workshops.

NEWSLETTER

The COPE Report was mailed to over 2,000 subscribers this year. This report rapidly disseminates research findings, announces upcoming educational opportunities, and highlights recent publications and topics of interest. The newsletter thus consistently and effectively informs cooperators and other interested persons about COPE activities and about general developments in resource management. This year's four issues are reprinted in the Appendix to this report.

PUBLICATIONS AND REPORTS

Ice, G.G., J.D. Stednick, and A.E. Skaugset. 1991. The new Alsea watershed study (NAWS). EOS, American Geophysical Union Transactions. October 29, 1991. 205 pages.

McMahon, T., G. Tucker, and S. Etessami. 1992. Research studies and publications of the Coastal Oregon Productivity Enhancement (COPE) Program 1987-1991. College of Forestry, Oregon State University. Newport, Oregon. 48 pages.

Tucker, G.F., and J.R. Powell. 1992. An improved canopy access technique. *Journal of Forestry* 89(11):31-35. Reprinted from *Northern Journal of Applied Forestry.*

Tucker, G.F., and J.R. Powell. 1992. (in press) An improved canopy access technique. *Arboricultural Journal* 16(4). Reprinted from *Northern Journal of Applied Forestry.*

Tucker, G., A. Skaugset, A. Hansen, R. Rhew, J. Schroeder, and S. McConnell. 1991. *Adaptive COPE Annual Report*, Oct. 1, 1990-Sept. 30, 1991. Forest Research Laboratory, College of Forestry, Oregon State University. Corvallis, Oregon. 30 pages.

WORKSHOPS AND FIELD TOURS

This past year the Adaptive COPE team cooperated in a major conference on the OSU campus, titled Design and Maintenance of Forest Road Drainage (see p.27). In addition, the Adaptive COPE team presented or cooperated in presenting the following workshops and field tours:

WORKING TOGETHER TO ENHANCE COQUILLE RIVER FISHERIES

September 19, 1991. Coquille, Oregon. 65 participants.

Workshop co-sponsored by COPE, Forestry Extension, and the Governor's Watershed Enhancement Board. Small woodland owners, biologists, and representatives from public agencies met to discuss potential strategies for improving riparian habitat on the Coquille River. They took a field tour on the east fork of the river to look at a Governor's Watershed Enhancement Board cooperative project.

COPE RESEARCH FIELD TOUR

July 11, 1992. Hatfield Marine Science Center, Newport, Oregon. Six participants.

Field tour for visiting soil scientists from Thailand. Co-sponsored by COPE and the OSU Office of International Research and Development. Central Oregon Coast Range. Technology transfer regarding COPE projects was discussed. Of particular interest were the riparian-zone studies and design and maintenance of forest road drainage.

CONSTRUCTING AND MAINTAINING FOREST ROADS

May 30, 1992. Hatfield Marine Science Center, Newport, Oregon. 45 participants.

Co-sponsored by COPE, OSU Extension Service, and Lincoln County Small Woodlands Association. Participants gathered to discuss how careful planning and design work can significantly reduce the high cost of road construction on private forested lands. Soils, slope, curve angles, stream crossings, drainage, access to public highways, and access to key parts of the property should all be considered in planning. This workshop was intended for private, non-industrial forest landowners. Those who attended were given information on the things to do before planning and construction begins, tools for identifying problem areas or good routes, problems to be prepared for once the work has begun, road maintenance to help avoid costly repairs, and protecting soil, water, and fisheries resources on the property.

DESIGN AND MAINTENANCE OF FOREST ROAD DRAINAGE

November 18-20, 1991. LaSells Stewart Center, OSU, Corvallis, Oregon. 110 participants.

The workshop was sponsored jointly by Adaptive COPE, the Oregon Department of Forestry, the OSU Forestry Engineering Department, and Forestry Extension.

DESIGN AND MAINTENANCE OF FOREST ROAD DRAINAGE

PROGRAM HIGHLIGHTS

November 18-20, 1991

Welcome and introduction—A. Skaugset, COPE

Why we are here: The importance of road drainage considerations in the design and maintenance of forest roads—K. Mills, ODF

Closing the gaps in knowledge, policy, and action for resource protection—P. Adams, OSU Forest Engineering

Principles of forest hydrology

An overview of the principles of forest hydrology—G. Ice, NCASI; A. Skaugset, COPE

Surface road drainage

An introduction to surface road drainage and water quality: The effect of aggregate quality, traffic, and cross drain location—K. Sullivan, Weyerhaeuser

Considerations in the placement of cross drain culverts—B. Beschta, OSU Forest Engineering

Considerations in the placement and construction of alternative surface road drainage techniques—H. Froehlich, OSU Forest Engineering

The design and performance of surface drainage for very steep forest roads—H. Rickard, USDA Forest Service

Considerations for the placement of surface road drainage outlets to mitigate landslide concerns in steep, landslide-prone terrain—D. Michael, ODF

Forest road drainage removal from abandoned or orphaned roads—N. Struhan, Washington DNR

Live stream crossings

Introduction to the management objectives for the design and maintenance of live-stream-crossing culverts—D. Wolfer, Washington DNR

Considerations for fish passage in the design and maintenance of live-stream-crossing culverts—T. Bumstead, RiverMasters, Inc.

Peak flow estimation and synthetic hydrograph techniques for small forested watersheds—M. Pyles, OSU Forest Engineering; A. Skaugset, COPE

The hydraulics of live-stream-crossing culverts—M. Pyles, OSU Forest Engineering; A. Skaugset, COPE

- **Overview of peak flow estimation techniques,**
- **The use of flow frequency analysis for peak flow estimation,**
- **The use of Campbell's equations for peak flow estimation,**
- **Flow transference and API as methods for generating synthetic hydrographs,**
- **An introduction to principles of flow resistance and open channel flow,**
- **The use of open channel flow principles and culvert hydraulics in determining culvert size for live stream crossings, and**
- **Class exercise in determining culvert size for a live stream crossing**—M. Pyles, OSU Forest Engineering; A. Skaugset, COPE.

COASTAL FORESTS AND BIG PICTURE FORESTRY

April 15, 1992. Salishan Lodge, Gleneden Beach, Oregon. 90 participants.

Field tour co-sponsored by Oregon Society of American Foresters and Adaptive COPE. Participants were given a tour with stops including Cascade Head Experimental Forest, Boise Cascade Co. and USDA Forest Service land, and OSU and Adaptive COPE study sites to view examples of competition and various harvest methods. Focus was on such issues as spotted owl critical habitat units, hardwoods as weeds or allies, and active riparian-zone management.

Forest management on Boise Cascade land along the coastal strip was discussed at Schooner Creek. Topics included short-rotation forestry, regeneration, and domestic water supplies. An alder-dominated riparian zone was visited, and conifer response to release and active management in riparian zones was discussed. A demonstration of tree girdling was given with a power girdler.

At a Forest Service "new forestry" unit, green tree retention, snags, down logs, vegetation management, and habitat for spotted owl were discussed. At Cascade Head, participants saw an alder-conifer competition study site that reveals relationships among western hemlock or Douglas-fir, red alder, salmonberry, and herbaceous vegetation.

Nearby, participants saw commercial thinning of precommercially thinned hemlock plantations where cable yarding with herringbone and uniform thinning patterns were used. Logging costs, stand structure, and wildlife habitat were discussed.

COASTAL FORESTS AND BIG PICTURE FORESTRY

ITINERARY

April 15, 1992

Introduction to field trip—B. Emmingham, OSU Forest Science

Forest management at Schooner Creek by the Sea—C. Sterling, Boise Cascade Co.

COPE riparian-zone conifer release study—G. Tucker, COPE, OSU; A. McGuire-Dale, USFS

Fisheries enhancement project—B. Emmingham, OSU Forest Science

Pin Cushion cutting unit—New Perspectives management—W. Patterson, Hebo R.D., Siuslaw National Forest

Cascade Head Experimental Forest—S. Greene, Pacific Northwest Research Station

Cascade Head alder-conifer competition study—G. Ahrens, T. Harrington, L. Cole, OSU Forest Science

Commercial thinning of pre-commercially thinned hemlock stands—L. Kellogg, OSU Forest Engineering

MANAGING ALDER STANDS

July 18, 1992. Olney, Oregon. 40 participants.

Co-sponsored by Adaptive COPE, OSU Extension Service, Oregon Department of Forestry, Oregon Department of Fish and Wildlife, and Oregon Small Woodlands Association. Woodland owners and foresters from western Oregon and Washington attended this workshop and field tour to learn about integrating wood, fish, and wildlife values into management of alder forests. Interested foresters, naturalists, and other concerned members of the public were invited to attend. Participants were given information on how alder stands grow naturally and after thinning, what managers can do to affect stand development (silvicultural options), and how fish and wildlife populations respond to stand conditions. Management options were examined in light of current opportunities and forest practice regulations.

MANAGING ALDER STANDS

AGENDA

July 18, 1992

Indoor session—Olney Grange

Greeting and introduction to workshop—M. Elefritz, OSU Extension

Overview of red alder ecosystem—G. Ahrens, OSU College of Forestry

Outputs of the red alder ecosystem: Wood—B. Emmingham, OSU Extension

Outputs of the red alder ecosystem: Fish—J. Casteel, Oregon Department of Fish & Wildlife

Incentives to manage: stewardship incentive program—T. Savage, Oregon Department of Forestry

Field session

Red alder: state of the resource—J. Christie, Oregon Hardwood Forest Products Resource Committee & Clatsop Small Woodlands Association

Tour of research plots: alder thinning, conifer underplanting—B. Emmingham & M. Bondi, OSU Extension

Managing alder stands for wildlife—D. VandeBerghe, Oregon Department of Fish and Wildlife

Managing riparian areas: opportunities and restrictions—J. Wolf, Oregon Department of Forestry

Controlling mountain beaver damage—M. Bondi, OSU Extension

Chemical thinning and control of red alder—D. Hibbs, OSU Extension

Closing comments and critique—B. Emmingham, OSU Extension

PRESENTATIONS

During the past year, Adaptive COPE team members gave a number of formal and informal presentations about COPE research and technology transfer activities. They met with a wide range of audiences, including:

- visiting soil scientists from Thailand
- officials from regional and national offices of the Bureau of Land Management
- representatives from the Siuslaw National Forest and U.S. Fish and Wildlife Service
- representatives from Boise Cascade Corp., Champion International Corp., Starker Forests, Inc., Stimson Lumber Co., Weyerhaeuser Co., Willamette Industries, Inc., and International Paper Co.
- county Extension agents
- the USDA Pacific Northwest Research Station
- visiting staff from OSU College of Forestry, Corvallis

In addition, the following technical presentations were given:

Skaugset, A.E. 1991. An overview of forest hydrology: precipitation frequency analysis and streamflow generation mechanisms in small forested watersheds. Presented at a workshop, Design and Maintenance of Forest Road Drainage, Nov. 18-20; Oregon State University, Corvallis.

Skaugset, A.E. 1991. Peak flow estimation and synthetic hydrograph techniques for small forested watersheds. Presented at a workshop, Design and Maintenance of Forest Road Drainage, Nov. 18-20; Oregon State University, Corvallis.

Skaugset, A.E. 1991. The effect of large woody debris piece size and orientation on aquatic habitat: first-year results. Presented to Northwest Forestry Association, Dec. 11; Forestry Sciences Laboratory, Corvallis, Oregon.

Skaugset, A.E. 1992. Review of Adaptive COPE research and technology transfer activities. Timber industry briefing, April 3; College of Forestry, Oregon State University, Corvallis.

Skaugset, A.E. 1992. Maintenance of forest roads. Presented at a workshop, Constructing and Maintaining Forest Roads for Small Woodlot Owners, May 30; Hatfield Marine Science Center, Newport, Oregon.

Skaugset, A.E. 1992. Adaptive COPE status report, new studies, and technology transfer, fiscal year 1993. Presented at the COPE Advisory Council meeting, June 2; LaSells Stewart Center, Oregon State University, Corvallis.

Skaugset, A.E. 1992. Adaptive COPE slope stability and root reinforcement. Presented at the NCASI field tour March 12, in the Mapleton area of the Central Oregon Coast Range.

Skaugset, A.E. 1992. COPE underplanting research. Presented at the Board of Forestry field tour April 16; Coos Bay, Oregon.

Tucker, G.F., W.H. Emmingham, and B.A. Schrader. 1991. Underplanting riparian areas in the Oregon Coast Range: growing trees for fish. Presented at the 82nd annual Western Forestry and Conservation Association Conference, Dec. 3-6; Victoria, British Columbia.

Tucker, G.F., A.E. Skaugset, R. Rhew, and A.J. Hansen. 1991. COPE: Coastal Oregon Productivity Enhancement. Poster presentation at the Society of American Foresters National Convention, Aug. 4-7; San Francisco, California; and abstract published in the Proceedings of the convention.

Tucker, G.F., Barbara A. Schrader, Eric G. Horvath. 1992. Restoration ecology of coastal Oregon riparian areas: an applied approach. Poster presented at the Ecological Society of America Convention, Aug. 10-13; Honolulu.

Tucker, G.F. 1992. Upland forest ecology. Training for Hatfield Marine Science Center and Oregon Coast Aquarium volunteers. Two lectures given in the spring.

Tucker, G.F. 1992. Interdisciplinary resource management. Guest lecture presented at agroecology course at The Evergreen State College, April 30; Olympia, Washington.

CONSULTATION

Adaptive COPE's location in Newport means that staff members have ready contact with Coast Range resource managers. These informal contacts provide an important and effective way of exchanging information. Throughout COPE's fifth year, individual team members have participated in many informal discussions, field trips, and impromptu meetings. These contacts will continue to be a significant part of the Adaptive COPE goal of transferring information among researchers, managers, and the general public.

ORGANIZATIONAL ACTIVITIES

The Adaptive COPE team was involved in a number of committees formed to address resource management topics related to various aspects of the COPE program. These assignments included:

- Forest science and technology committee of the Oregon Chapter of the Society of American Foresters (G. Tucker)
- Forest Science and Technology Canopy Access Steering Committee of the Olympic Natural Resources Center, University of Washington (G. Tucker)
- Steering Committee for the Conference on Forestry in the 21st Century, Olympic Natural Resources Center, University of Washington (G. Tucker)
- Chair of the Communications Subcommittee for the preparation of the 10-year plan for the OSU Department of Forest Science (G. Tucker)
- Oregon Department of Forestry Forest Road Drainage Working Group (A. Skaugset)

PLANS FOR FISCAL YEAR 1993

RESEARCH

- Continue work on studies listed in this report.
- Reinitiate work on assessing stability of end-haul disposal areas.

EDUCATION

- Publish four newsletters.
- Conduct workshops on a regional assessment of stream habitat inventory and monitoring programs (January 1993).
- Conduct a workshop on slope stability, soil compaction, organic debris in streams, and riparian-zone management.
- Conduct a workshop on commercial thinning to enhance wildlife habitat.
- Prepare a manuscript on modeling of root reinforcement in shallow forest soils.
- Prepare a manuscript on wildlife abundance and diversity in managed upland forest landscapes.
- Prepare a manuscript on simulating forest and wildlife habitat dynamics in managed forests.
- Prepare a manuscript and other reports on the response of cutthroat trout to timber harvest.
- Prepare a manuscript on large woody debris and fish habitat in Coast Range streams.
- Continue consultations, field trips, and meetings with cooperators.
- Continue to increase public awareness of the COPE program.
- Produce an Adaptive COPE Annual Report for FY 1993.

BUDGET SUMMARY FOR FY 1992

Approximate Expenditures		Revenue Sources	
Personnel	$268,172	Federal Agencies	$287,000
Services & Supplies	88,445	State Agencies	55,500
Travel	21,697	Industry	140,000
Equipment	9,251	Counties	17,500
Indirect Costs	18,916	Associations	200
		Carryover	117,076
Total	$406,481	Total	$617,276

ANTICIPATED BUDGET FOR FY 1993

Approximate Expenditures		Revenue Sources	
Personnel	$305,000	Federal Agencies	$256,000
Services & Supplies	52,000	State Agencies	60,500
Travel	41,000	Industry	150,000
Equipment	40,000	Counties	17,500
Indirect Costs	20,000	Associations	200
		Carryover	210,795
Total	$458,000	Total	$694,995

APPENDIX

COPE REPORT

This is a quarterly newsletter highlighting COPE research activities, forthcoming educational opportunities, and recent publications and topics of interest. To receive it, write or phone:

Adaptive COPE Program
Hatfield Marine Science Center
2030 S. Marine Science Drive
Newport, Oregon 97365-5296
(503) 867-0220

COPE Report

Coastal Oregon Productivity Enhancement Program

Promoting Integrated Management of Oregon's Coast Range Forests Through Research and Education

Volume 4, Number 4 — Fall 1991

The COPE Program

The Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative effort between Oregon State University's (OSU) College of Forestry, the USDA Forest Service Pacific Northwest Research Station (PNW), the USDI Bureau of Land Management (BLM), other federal and state agencies, forest industry, county governments, and the Oregon Small Woodland Association. The intent of the program is to provide resource managers and the public with information relative to the issues and opportunities associated with the management of fish, timber, water, wildlife, and other resources of the Oregon Coast Range. The COPE Program emphasizes an integrated approach—an integration of research and education and an integration of scientific disciplines—to find effective ways to manage these diverse resources collectively.

The COPE Program has two related components: Fundamental COPE and Adaptive COPE. Comprised of OSU and PNW scientists based primarily in Corvallis, Fundamental COPE addresses problems related to riparian zone management and reforestation in the Coast Range through basic research. Adaptive COPE is comprised of an interdisciplinary team responsible for applying and adapting new and existing research information to solve specific management problems. Stationed on the coast in Newport at the Hatfield Marine Science Center, the Adaptive COPE team is also responsible for providing continuing education opportunities to facilitate technology transfer.

Published quarterly, the COPE Report provides a means to rapidly disseminate research findings, announce upcoming educational opportunities, and highlight recent publications and topics of interest. Its goal is to foster good resource management by helping people involved in the management of Oregon Coast Range resources to stay well-informed. Comments and suggestions concerning the content of the COPE Report are welcomed and encouraged. To receive this free newsletter, contact COPE, Hatfield Marine Science Center, Oregon State University, Newport, OR 97365. Phone: (503) 867-0220.

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ADAPTIVE COPE

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Because of space limitations, articles appear as extended abstracts. Results and conclusions may be based on preliminary data and/or analysis. Readers interested in learning more about a study should contact the principal investigator or wait for formal publication of more complete results. For specifics on the overall COPE Program, contact Steve Hobbs, COPE Program Manager, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331, (503) 750-7426; or Gabriel Tucker, Adaptive COPE Coordinator, 2030 S. Marine Science Dr., Newport, OR 97365, (503) 867-0220.

ADAPTIVE COPE

MORE NEW NAMES AND FACES

Often, these days, we hear that both the magnitude and pace of change in forestry today is without parallel. An example of that change is what is happening to the Adaptive COPE program brought on by both the magnitude and pace of recent changes in personnel.

While turnover in a program like Adaptive COPE is never pleasant, it is encouraging to see the job quality that former Adaptive COPE employees are enjoying and to realize that experience gained from Adaptive COPE is being spread throughout the Pacific Northwest. Steve McConnell, the initial silviculture research assistant, resigned from Adaptive COPE in June, 1991, to accept a graduate research assistantship and enter a Ph.D. program in silviculture at the University of Idaho. Marcy Berg resigned her position as secretary/receptionist in June, 1991, to accept a position as office coordinator with the Oregon Department of Transportation in Bend, Oregon. Jim Schroeder, the soils/hydrology research assistant, resigned in September, 1991, to accept a position with Arctic Hydrologic Consultants in Fairbanks, Alaska. Ron Rhew, the fisheries research assistant, resigned in December, 1991, to accept a career track position with the U. S. Fish and Wildlife Service in Portland, Oregon. Pei-Fen Lee, the wildlife research assistant, resigned in December, 1991, to accept a faculty position with the National Taiwan University. Finally, Andy Hansen, the Wildlife Habitat Scientist and the third person ever hired at Adaptive COPE, resigned his position as of January, 1992. Andy has moved to the Oregon State University campus where he will join Joe Means in leading the Fundamental COPE integration study. We would like to wish all these former colleagues continued success with their careers.

We are continuing to fill these vacant positions as allowed by contemporary budget and administrative restraints. As of this writing, two positions have been filled: the office coordinator and silviculture research assistant. The office coordinator position, which was upgraded after Marcy resigned, was filled in October, 1991, by Skye Etessami. Skye comes to Adaptive COPE from the Human Resources Department at Oregon State University where she was a personnel specialist for five years. The silviculture research assistant position was filled by Barbara Schrader. Barbara comes to Adaptive COPE from the University of Washington where she just recently received an M.S. in Forest Ecology to go with a B.S. in Wildlife Resources from the University of Idaho. In addition to filling these two positions, Pat Hounihan has been rehired to pick up some of the slack created by the current vacancies. Pat has worked in a temporary capacity previously for both Adaptive COPE and to carry out COPE wildlife research in the H.J. Andrews Experimental Forest.

As always, if you are in the Newport area, please come by and say "Hi" and get acquainted with the new Adaptive COPE employees.

AES

MANAGING FOREST ROAD DRAINAGE

Forest roads can be one of the most persistent legacies of forest land management. Forest roads have re-

peatedly been indicted as the single greatest source of accelerated erosion, including both road-related landslides and surface erosion, resulting from forest land management. The sediment from road-related accelerated erosion can damage aquatic habitat, adversely impacting fisheries. In addition to aquatic habitat damage, serious road-related erosion invariably leads to the need for long-term, costly road maintenance programs. A key to minimizing forest road impacts on aquatic resources, as well as protecting the capital investment that is the road, is to provide and maintain adequate forest road drainage. This road drainage must include adequate passage for large streams crossed by forest roads, as well as the drainage for runoff generated by the road surface, either from precipitation or the interception of subsurface flow.

During November 18-20, 1991 Adaptive COPE, in conjunction with the Oregon Department of Forestry, the OSU Forest Engineering Department, and OSU Forestry Extension, held a three-day short course on "The Design and Maintenance of Forest Road Drainage." The objectives of the short course were to review contemporary concepts of forest hydrology, to present accepted concepts and methods, and to offer some limited training in state-of-the-art techniques for providing drainage for live stream crossings and surface road drainage.

The three day session was held in two parts. The first part consisted of three sessions scheduled over 2 days. The sessions included an overview of the principles of forest hydrology, live stream crossing culverts, and surface road drainage. Approximately 110 participants attended the first 2 days of the short course. During those 2 days material was presented on the effect of road drainage on water quality, cross drain culverts, surface road drainage alternatives to cross drain culverts, drainage of very steep forest roads, peak flow estimation for small forested watersheds, fishery requirements for stream crossing culverts, and culvert hydraulics.

The second part of the short course was a 1-day session that consisted of an in-depth treatment of live stream crossing culverts. Fifty participants attended this session. The morning consisted of methods of peak flow estimation for small forested watersheds. The methods presented consisted of the Rational formula, frequency analysis, Campbell's equations, direct flow transference, and the Antecedent Precipitation Index (API). The afternoon was dedicated to an in-depth treatment of culvert hydraulics.

These short courses are often perceived as being too conceptual and not presenting any tangible management tools. At this short course George Ice undertook to change that perception by presenting some very solid management advice. Presented here, intact, is George Ice's list of "The Top Five Ways Not to Justify a Culvert Size."

5) It was the only size we had in stock.

4) This is our most popular size.

3) When we calculated the flow it was too large so we adjusted the culvert to a more reasonable size.

2) My boss said it was OK.

1) If it turns out to be too small and fails we'll put in a larger one.

AES

FUNDAMENTAL COPE

VEGETATION DYNAMICS IN MANAGED COASTAL RIPARIAN AREAS

Riparian ecosystems provide many valuable resources. In addition to providing fisheries habitat, riparian ecosystems provide habitat for a wide variety of wildlife species, drinking water for domestic use, and recreational resources. Crucial to these resources is riparian vegetation. Creation of riparian zone buffer strips with the associated exposure of the riparian community to increased light, wind, and overland water flow can have profound effects on riparian vegetation. These effects include increased understory development, changes to the woody components of the forest floor, and accelerated senescence of the overstory. Because of the dynamic nature of riparian zones, it is especially important to determine the immediate and long-term impacts of management activities on riparian ecosystems.

This study is one of several investigating riparian vegetation. Most of these studies focus on conifer dominated riparian areas. Many of the riparian areas in the coast range have overstories dominated by red alder. The relatively short life of red alder and the dense shrub communities underneath the alder suggest that these alder dominated riparian areas will succeed to shrubs without active management. This study was designed to examine how management, specifically the creation of riparian buffer strips, affects the structure and dynamics of riparian vegetation.

Riparian vegetation was sampled along 54 different streams in the northern and central Oregon Coast Range. Sites were selected to sample a range of stream sizes, topographic characteristics, and time since buffer strip creation. Sampling focused on alder dominated riparian areas. In addition to selecting sites with buffer strips adjacent to the stream, several undisturbed alder riparian sites were also selected for comparison. Data on understory and overstory vegetation cover and species, shrub height, overstory basal area, abundance of regeneration, and geomorphology (topography and stream characteristics) were collected on transects extending from the stream edge upslope to the management unit edge. Geomorphology varied considerably across the sample sites, ranging from small, high elevation, highly constrained to large, low elevation, unconstrained streams.

The results indicate that geomorphology is important to riparian vegetation structure and dynamics in alder buffer strips. Vegetation characteristics on terraces adjacent to streams differed from vegetation on slopes (Figure 1). Total shrub cover, including sword fern, was lower on terraces than slopes (95 percent vs. 132 percent). Overstory basal area and cover were higher on terraces than slopes. The major shrub components — vine maple, thimbleberry, salmonberry, elderberry, and huckleberry — had similar cover on terraces and slopes. Sword fern, however, accounted for much of the increase in shrub cover on slopes. Salmonberry and sword fern were the two most dominant understory species on slopes, averaging 48 and 31 percent cover, respectively. On terraces, salmonberry and vine maple dominated with 49 and 17 percent cover, respectively. Time since buffer creation had little direct effect on total shrub cover of terraces and slopes. However, shrub cover decreased as buffer width increased.

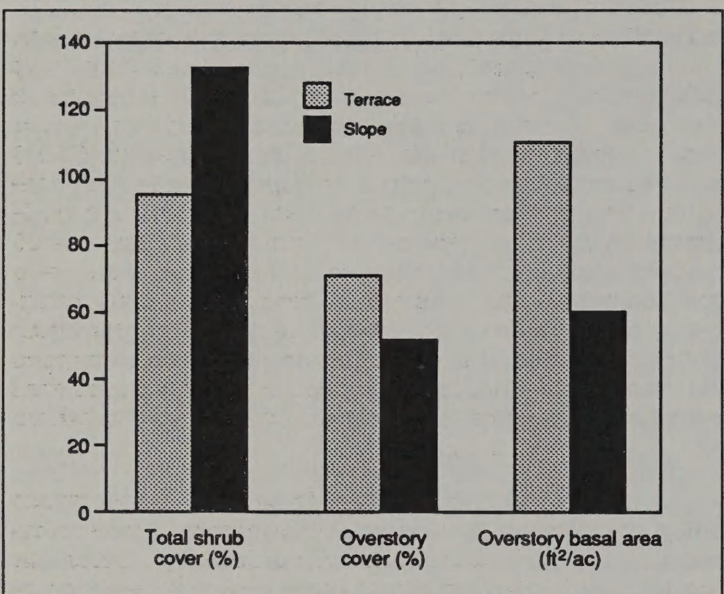

Figure 1. Vegetation characteristics and geomorphology of buffer strip alder riparian areas.

Undisturbed alder riparian area vegetation generally was not different from vegetation in buffer strip areas. Basal area and overstory cover were also similar. Total shrub cover was slightly higher in buffer strips, primarily due to higher salmonberry cover (Figure 2). Although vegetation components in undisturbed alder riparian areas were not related to geomorphology, vegetation components on slopes differed between undisturbed and buffer areas. Total shrub cover was higher on buffer slopes (132 percent vs. 99 percent), overstory basal area was lower (60 vs. 120 sq. ft./ac.), and overstory cover was lower (52 percent vs. 73 percent).

Regeneration was very sparse on all sites. Only 28 seedlings were found at the 54 sample sites (Figure 3). Hardwood seedlings (bigleaf maple and red alder) represented 37 percent of the total number of seedlings. Conifer seedlings were evenly distributed among Sitka spruce, Douglas-fir, and western hemlock. Bigleaf maple, red alder, and Douglas-fir were found predominantly on mineral soil, while western hemlock was found mainly on woody debris. Sitka spruce was intermediate, with 60 percent and 40 percent being found on woody debris and mineral soil, respectively. Because of low regeneration in these riparian areas, relationships between regeneration and environmental conditions were not detected. Even so, light penetration through the overstory canopy in these riparian areas is extremely low. Light levels at the top of the understory vegetation were generally less than 20 percent of light levels in the open. Low light penetration through the overstory canopy and a dense understory layer decreases conifer seedling viability.

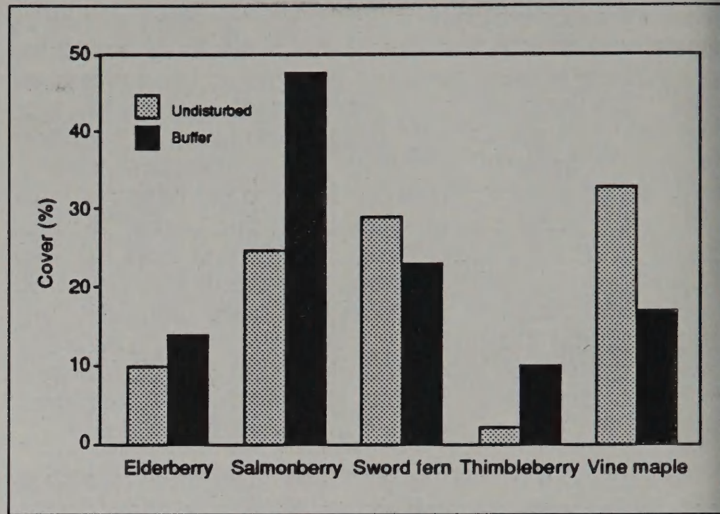

Figure 2. Cover of primary shrub species in undisturbed and buffer strip alder riparian areas.

The results of this study support the hypothesis that geomorphology is important to riparian vegetation composition and structure. Greater shrub cover and lower basal area on slopes increase the potential for these sites

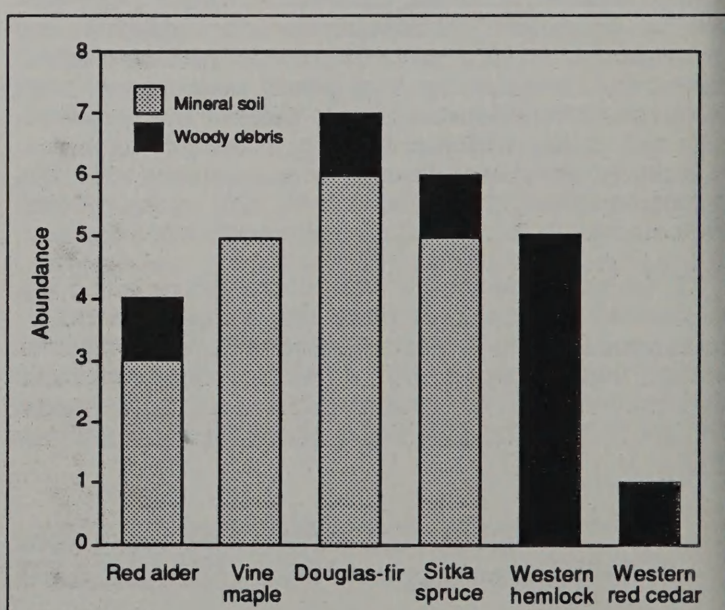

Figure 3. Regeneration in alder riparian areas.

to develop into shrub dominated communities. The increase in sword fern on slopes and the development of a salmonberry/sword fern community is potentially inhibitive to tree regeneration and herbaceous plant development. Sword fern generally forms a secondary understory canopy beneath salmonberry which effectively uses most of the light penetrating the salmonberry.

The lack of regeneration in alder dominated riparian areas is not surprising. Several studies in conifer dominated riparian areas have found similarly sparse regeneration. Alder riparian areas may be particularly susceptible to poor conifer regeneration due to low light levels, lack of a conifer seed source, and lack of a suitable seedbed. Conifer woody debris is thought to be necessary for conifer regeneration. Conifer woody debris was not abundant in our study sites and large disturbances that encourage regeneration of hardwoods were lacking.

The similarity in vegetation between undisturbed alder riparian terraces and alder buffer strips on terraces indicates that the creation of buffer strips in these types of systems seems to maintain the integrity of the premanagement riparian vegetation. However, the lack of tree regeneration and the extremely dense shrub canopy in both undisturbed and buffer strip areas suggests the potential for these communities to develop long-lasting shrub communities once the alder canopy senesces.

In addition to further work in conifer dominated and hardwood/conifer mixed buffer strips, this study will also investigate seedling performance in riparian areas. Several overstory and understory treatments will be tested, as well as several tree species. This information, combined with information from the buffer strip sampling, should provide a basis for making management decisions that protect resource values in coast range riparian areas.

David E. Hibbs and Peter Giordano,
OSU Forest Science Department
Samuel Chan, PNW

HYBRID POPLAR AND RED ALDER IN COASTAL RIPARIAN ZONES FOR CONTROL OF NONPOINT-SOURCE POLLUTION, FISH AND WILDLIFE HABITAT, AND WOOD FIBER

Intensive agriculture has contributed substantially to water quality degradation through the leaching and runoff of urine, manure, fertilizers, and herbicides that are applied to crops. It has also contributed increasing amounts of nutrients to lakes and streams as agricultural practices have intensified, and agricultural development has expanded to accommodate a growing human population. The public is now demanding that the agriculture industry be held accountable for its effects on water quality. Current research results illustrate that the 10 mg/L limit for nitrate-nitrogen in lakes and streams cannot be met using currently accepted farming practices. Of particular concern in western Oregon are dairy farms which produce high volumes of nitrogen in urine and where only a limited land base is available for recycling this by-product. Most dairy pastures are adjacent to streams and/or estuaries.

Many studies on the eastern seaboard and in Europe have demonstrated the effectiveness of riparian buffer strips in protecting stream waters from nonpoint-source inputs of nutrients. These studies were placed on agricultural lands where fertilizer leaching was a severe problem.

Riparian vegetation can act as an absorbent of nutrients moving through both ground and surface water. Peterjohn and Correll (1984), for example, estimated an annual net removal of 45 kg/ha of nitrate-nitrogen from subsurface waters from fertilized cropland as the groundwater crossed through 50 m of riparian forest. They also reported substantial decreases in particulate organic-N and particulate-phosphorus from surface waters. In Europe and the eastern United States, forest buffers retain as much as 89 percent of the nitrogen and 80 percent of the phosphorous runoff associated with adjacent land use practices (Pinay 1986). Following a 3-year study of a Georgia coastal plain watershed, Lowrance et. al. (1984) reported that riparian forests provide an excellent nutrient sink for the surrounding agricultural lands. Over a 1-year period, 68 percent of total-nitrogen inputs and 30 percent of total-P inputs to an agricultural area were retained in the surrounding riparian ecosystem. Long-term field studies in forest watersheds of Oregon's Coast Range revealed nitrate increases of 400 percent for areas clearcut to stream edges. However, no increase in stream nitrate loading was evident downslope of clearcuts where buffer strips were retained.

The limiting habitat in the life cycle of anadromous fish may be our coastal estuaries. Many of these estuaries are surrounded by farmland, particularly dairies. In these areas, bank stability, the physical configuration of fish habitat, and water quality are often in poor condition. Water quality problems related to nonpoint source pollution include high temperatures, high bacteria levels, and high nitrate concentrations. Even narrow riparian forest strips are effective filters particularly when adjacent to cropland. Small side channels and the merger of rivers are potentially excellent salmonid habitat. However, because of past human disturbance, many of these areas are currently unproductive rearing habitat for young salmonids.

Hybrid poplar plantations are used successfully along water courses in France for wildlife habitat, ground water nutrient filters, and fiber production. On test plots in the Pacific Northwest, hybrid poplar have grown to over 60 feet high and attained a diameter of more than 7 inches in 8 years. The purpose of the COPE Filter Belt Study is to test the French model in the Oregon Coast Range. If successful, it would represent an excellent example of forest management and environmental protection resulting in better fish and wildlife habitat, cleaner rivers and bays, and an alternative high yield fiber supply.

Native red alder also has high growth and economic potential and it will also be tested. Red alder occurs in abundance in riparian areas of the Oregon and Washington coast range especially in estuaries where cottonwood is noticeably absent. Red alder may provide the land manager with a more valuable manageable tree species because it can be grown not only for its value as pulpwood but also for its value as furniture stock.

Objectives

The objective of this experiment is to determine the effectiveness of riparian buffer strips of hybrid poplar (*Populus trichocarpa* x *deltoides*) and red alder [*Alnus rubra* (Bong.)] for reducing nitrogen and herbicide concentrations from ground water draining agricultural lands.

Experimental Plan

Field Study

The field study was implemented in the dairy regions of Oregon's coastal farmlands. Plots 100 m x 30 m were planted to hybrid cottonwood and red alder in riparian zones of three different secondary streams. Manure or herbicide application rates will be monitored and, at some point, may be manipulated to test the capacity of the filterbelt to absorb nutrients. Ground water moving through the plantations will be sampled via access tubes at various depths. These research sites will provide an early assessment of the length of time required to stabilize stream banks and effectively filter nutrients and herbicides from ground water entering streams.

Three sites, Oak Creek, Wolf Creek, and Zollner Creek, were chosen to test the effectiveness of filterbelts in western Oregon. Each site has an active dairy operation which applies manure to the fields on a regular basis.

Oak Creek

Hybrid cottonwood were planted on this site in spring 1989. During the summer the cottonwood were irrigated. There was 95 percent survival. In the spring of 1990, red alder were planted but most of these trees died due to a severe drought that year. Red alder was replanted in 1991 and was irrigated every 3 weeks by the OSU dairy farms. Survival was mediocre and planting of red alder to fill in gaps is planned for spring of 1992. Plots received two applications of glyphosate each year: one in the spring and one in the summer.

In the fall of 1990, OSU dairy cows broke through the electrical fence and did considerable damage to the cottonwoods and alder. A barbed wire fence was constructed to keep the cows from doing further damage. The cottonwoods recovered and grew well during the early spring of 1991. However, by mid-summer 1991, beavers moved into the area and felled two-thirds of the cottonwoods. No alder was damaged. A permit was obtained from the Oregon Department of Fish and Wildlife and the beavers were removed. In late summer, 1991, nutria moved in, caused additional damage, and were subsequently removed. An additional rodent fence is scheduled to be constructed by the spring of 1992. The cottonwoods will likely resprout and grow well in 1992.

Wolf Creek

Hybrid cottonwood and red alder were planted in the spring of 1990. Initial survival was excellent. A freeze in January, 1991, killed all the cottonwood and alder on this site. The plot was replanted in the spring of 1991 after an application of 3 percent glyphosate. Initial survival was greater than 90 percent. The plot received an additional application of 3 percent glyphosate in the summer of 1991. All trees are growing well. Cows are fenced out of this plot.

Zollner Creek

A plot of cottonwoods was planted in the spring of 1991 after an application of 3 percent glyphosate. Survival of these trees is greater than 85 percent. John and Joe Duda, the farmers, have irrigated the trees. The plot received an additional application of 3 percent glyphosate in the summer of 1991. Red alder is scheduled to be planted on this site in the spring of 1992.

The Soil Conservation Service (SCS) constructed a wetland on this site in the summer of 1991. We are cooperating with the SCS to reduce nitrogen input to streams from dairy manure on this site. For further information contact Monty Grahm, Soil Conservation Service, Salem, OR (503-399-5746).

Additional Research

The extensive use of herbicides in agricultural regions of the United States and Canada has been well documented. Current agricultural practices are responsible for the deposition of millions of kilograms of herbicides into lakes and streams throughout the United States. The persistence of atrazine (2 chloro-4[ethylamino]-6[isopropylamino]-S-triazine) and 2,4-D (2,4 dichlorophenoxyacetic acid) in the environment has generated much concern because of their potential effects on human health.

The type of vegetation growing on a particular soil will have profound effects on the microbial community inhabiting that soil. Forest vegetation, through litter deposition, provides a favorable environment for the development of a rich soil fungal community. Riparian areas that were formerly used as pasture and converted to coniferous or hardwood forest may provide a soil ecosystem with higher microbial activity than pasture adjacent to the stream.

Research is ongoing, testing the influence of riparian forest filterbelt and pasture vegetation on microbial degradation of 2,4-D and atrazine in soils. Soil samples are

taken to the laboratory and kept in controlled environmental conditions. Known amounts of 2,4-D and atrazine are introduced into the sample and degradation is monitored. Riparian soils have been sampled seasonally. Fall samples are scheduled to be taken in mid to late November 1991 and the statistical analysis is complete on the spring and summer 1991 samples. Three reports will be drafted in January of 1992. Projected titles and authors are:

The Influence of Riparian Forest and Pasture Vegetation on Microbial Degradation of Herbicides in Soil. J.A. Entry, P.K. Donnelly, and W.H. Emmingham. Journal of Environmental Quality.

Degradation of 2,4-D and Atrazine by *Phanerochaete chrysosporium* and *Trappea darkeri* Added to Riparian Forest Soils. J.A. Entry, P.K. Donnelly, and W.H. Emmingham. Applied and Environmental Microbiology.

The Influence of Forest Age on Microbial Degradation of Herbicides in Riparian Soils. J.A. Entry, P.K. Donnelly, and W.H. Emmingham. Journal of Environmental Quality.

The influence of vegetation on soil nutrient storage is also being tested. Preliminary results indicate that forest vegetation increases the nutrient storage capacity of soils compared to pasture vegetation. Preliminary results also indicate that as forest age increases so does the nutrient storage capacity of riparian soils. Project titles and authors are:

The Influence of Riparian Forest and Pasture Vegetation on Nutrient Storage Capacity of Riparian Soils. J.A. Entry and W.H. Emmingham. Soil Science Society of America Journal.

The Influence of Forest Age on Nutrient Storage in Riparian Soils. J.A. Entry and W.H. Emmingham. Soil Science Society of America Journal.

Recommended Readings

Lowrance, R., R. Todd, J. Fail, Jr., O. Hendrickson, Jr., R. Leonard, and L. Asmussen. 1984. Riparian forests as nutrient filters in agricultural watersheds. BioScience 34(6):374-377.

Peterjohn, W.T., and D.L. Correll. 1984. Nutrient dynamics in an agricultural watershed: Observations of the role of a riparian forest. Ecology 65(5):1466-1475.

Pinay, G. 1986. Impact of a riparian forest on the nitrogen content of phreatic water in the Garonne Basin. P. 303-317 *in* J. Lauga, H. Dicamps, and M.M. Holland eds. Land use impact on aquatic ecosystems, Proceedings of the Toulouse Workshop. MAB-UNESCO and PIREN-CNRS.

James A. Entry and W.H. Emmingham,
OSU Forest Science Department

OPPORTUNITIES

A SYMPOSIUM ON A REGIONAL ASSESSMENT OF STREAM HABITAT INVENTORY AND MONITORING PROGRAMS

This symposium planned for May 13-14, 1992 has been postponed until November or December, 1992. The sponsorship, objectives, and scope of the symposium remain unchanged; however, the location and other logistics may change. Details of the program, the formal program announcement, and registration details will appear in this section of future issues of the COPE Report. For further details contact the Conference Assistant, OSU, 202 Peavy Hall, Corvallis OR 97331-5707 or phone (503) 737-2329.

OREGON SOCIETY OF AMERICAN FORESTERS ANNUAL MEETING

April 12-14, 1992 **Lincoln City, OR**

The Oregon Society of American Foresters' 1992 Annual Meeting will be held at the Salishan Lodge in Gleneden Beach, April 12-15. This year's theme is "Big Picture Forestry: Dealing with the Changing Scope of our Profession." A slate of excellent speakers will focus on the future of forestry. There will be discussions on science and technology, ethics, politics, silviculture, engineering, products, and other timely topics. This year the concurrent sessions have been structured to allow for greater audience participation and interaction.

The meeting will start Sunday night with an ice breaker and a poster session. There will be an alumni breakfast Monday morning. General and concurrent sessions will follow. There will be an awards banquet Monday night preceded by a social hour. A pep-up breakfast will kick-off Tuesday's activities which include concurrent and plenary sessions. A full slate of spouse's tours and activities is scheduled for Monday and Tuesday and there will be a field trip on Wednesday (see next item).

For further information contact the OSU Forest Science Department at (503) 737-2244. For registration information, contact Starker Forests, Inc., P.O. Box 809, Corvallis, OR 97339, (503) 929-2477.

BIG PICTURE FIELD TOUR

April 15, 1992 **Lincoln City, OR**

A field tour will be held in conjunction with the annual meeting of the Oregon Society of American Foresters. The field tour will follow the theme of the annual meeting, "Big Picture Forestry: Dealing with the Changing Scope of our Profession," and will explore how forest management is changing in coastal Oregon forests. Such issues as spotted owl habitat, riparian zone management, hardwood management, and harvest methods research

will be discussed. The field tour will visit the Cascade Head Experimental Forest and Boise-Cascade and US Forest Service land. The cost of the field tour is $16 which includes transportation, refreshments, and lunch. You do **not** have to be an SAF member or attend the OSAF annual meeting to go on this field trip. It is open to the public. For further information contact the OSU Forest Science Department at (503) 737-2244. For registration information, contact Starker Forests, Inc., P.O. Box 809, Corvallis, OR 97339, (503) 929-2477.

RECENT PUBLICATIONS

MANAGING RIPARIAN AREAS ON FOREST LANDS a slide-tape by Paul Adams and Tom McMahon. The OSU Forestry Media Center has just released a slide-tape, which should be of considerable interest to COPE cooperators and others in the region. Riparian areas are now widely recognized as unique and vital parts of forest lands, and they have been receiving growing attention from resource managers and landowners who must make decisions about managing these important sites. This program provides a thorough overview of forest riparian management, in an effort to promote sound and economical management strategies. The slide-tape summarizes our current understanding of the nature, functions, and benefits of riparian areas on forest lands. Then it examines the potential effects of forest practices on riparian functions and benefits, and discusses major challenges and research results. Field photos and high-quality graphics are used to illustrate key principles for a broad audience — from field foresters, to woodland owners, to natural resource policy makers.

Managing Riparian Areas on Forest Lands is 28 minutes long, and available in two formats: a slide-tape package (including 127 slides and both audible and inaudible tone audio cassette soundtracks) or as a slide-to-video transfer (VHS). Each program comes complete with a script. Purchase price is $130.,5-day rental $25. To order (request Slide-Tape #987 S-T, or VHS Video Transfer #987 V-T) or for more information contact: Forestry Media Center, OSU, Peavy Hall 248, Corvallis, OR 97331-5702. Phone, (503) 737-4702.

PWA

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Research Station

COPE Report

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Volume 5, Numbers 1 & 2 Winter 1991/Spring 1992

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The Coastal Oregon Productivity Enhancement (COPE) Program is a cooperative effort between Oregon State University's College of Forestry, the USDA Forest Service, Pacific Northwest Research Station, the USDI Bureau of Land Management, other federal and state agencies, forest industry, county governments, and the Oregon Small Woodland Association. The intent of the program is to provide resource managers and the public with information relative to the issues and opportunities associated with the management of fish, timber, water, wildlife, and other resources of the Oregon Coast Range. The COPE Program emphasizes an integrated approach—an integration of research and education and an integration of scientific disciplines—to find effective ways to manage these diverse resources collectively.

The COPE Program has two related components: Fundamental COPE and Adaptive COPE. Comprised of OSU and PNW scientists based primarily in Corvallis, Fundamental COPE addresses problems related to riparian zone management and reforestation in the Coast Range through basic research. Adaptive COPE is comprised of an interdisciplinary team responsible for applying and adapting new and existing research information to solve specific management problems. Stationed on the coast in Newport at the Hatfield Marine Science Center, the Adaptive COPE team is also responsible for providing continuing education opportunities to facilitate technology transfer.

Published quarterly, the COPE Report provides a means to rapidly disseminate research findings, announce upcoming educational opportunities, and highlight recent publications and topics of interest. Its goal is to foster good resource management by helping people involved in the management of Oregon Coast Range resources to stay well-informed. Comments and suggestions concerning the content of the COPE Report are welcomed and encouraged. To receive this free newsletter, contact COPE, Hatfield Marine Science Center, Oregon State University, Newport, OR 97365. Phone: (503) 867-0220.

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ADAPTIVE COPE

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Because of space limitations, articles appear as extended abstracts. Results and conclusions may be based on preliminary data and/or analysis. Readers interested in learning more about a study should contact the principal investigator or wait for formal publication of more complete results. For specifics on the overall COPE Program, contact Steve Hobbs, COPE Program Manager, Forestry Sciences Laboratory, 3200 SW Jefferson Way, Corvallis, OR 97331, (503) 750-7426; or Arne Skaugset, Interim Coordinator, Adaptive COPE, 2030 S. Marine Science Dr., Newport, OR 97365, (503) 867-0220.

FROM THE PROGRAM MANAGER

This year the COPE Program has 33 cooperating organizations, an intensified educational program and 39 research studies that involve 51 scientists from the USDA Forest Service Pacific Northwest Research Station, Oregon State University, and other cooperating organizations. These efforts cover a wide array of subjects such as silviculture, fisheries, wildlife, slope stability, forest pathology, recreation, and economics. During the next 6 years, however, as we move toward the program's conclusion in 1998, emphasis will be increasingly shifted toward the development of information that integrates these subjects. It is essential that we understand how forest and stream ecosystems function, interact, and respond to natural disturbance and management activities. Our intent is to develop information that will enhance forest and stream productivity and thus increase the economic and social values derived from integrated resource management. I am particularly encouraged by our scientists' efforts to better understand the relationships between silviculture, fisheries, and wildlife and to explore new ideas that may better enable us to meet the needs of society.

As you read this issue of the *COPE Report*, remember that the information presented in any one issue represents only a small percentage of the total effort. However, with each issue the editor will assemble reports that cover new subjects that we think will be of interest to you. I view this report as one of the most effective ways of reporting to you what we are finding. Let us know what you like or don't like about the newsletter and what we can do to better meet your information needs. The *COPE Report* now has a readership of over 2,000 people.

Steve Hobbs

ADAPTIVE COPE

NEW WILDLIFE HABITAT SCIENTIST AT ADAPTIVE COPE

John P. Hayes, Ph.D. Wildlife Ecology has joined the Adaptive COPE team. He and his family moved May 18th to the Alsea River area near Waldport.

John comes to us from the Department of Zoology at the University of Tennessee in Knoxville where he held a post-doctoral fellowship. John received his Ph.D. in Ecology and Evolutionary Biology from Cornell University in New York in 1990. There, his research dealt with the biogeography, systematics, and conservation of woodrats in the eastern United States.

Before moving to New York, John received his M.S. in Biology at Southern Oregon State College in 1983, and a B.S. in Wildlife Science at Oregon State University in 1978.

John has held a number of positions working with wildlife and fish for the Bureau of Land Management and the Forest Service in Oregon and Wyoming.

His publications include popular articles on sea otter, giraffes, hummingbirds, condors, and bears. Scientific publications encompass the ecology of small mammals in the

Pacific Northwest, genetics, morphometrics, conservation biology, and biostatistics.

With such a diverse background, John is a welcome addition to the Adaptive COPE team.

Skye

AN APPROACH FOR MANAGING VERTEBRATE DIVERSITY ACROSS MULTIPLE-USE LANDSCAPES

Many forest managers now consider the maintenance of biological diversity to be an important management objective. Unfortunately, the two main approaches used in the United States for conserving species, land preservation and endangered-species strategies, appear to be insufficient. Consequently, many ecologists now recommend that these traditional approaches be complemented with efforts to use ecological principles to design landscapes both for biodiversity and commodity production.

No one is quite sure, however, how to protect "genetic, species, ecosystem, and landscape diversity" on lands intensively managed for wood, forage, and other products. Land managers are now wrestling with such difficult questions as:

- How can we deal with the present lack of knowledge on biodiversity?
- What elements of biodiversity can realistically be maintained and over what spatial and temporal scales?
- What systems can best identify the likely impacts of alternative management on biodiversity and other resources?
- How can biological diversity be monitored to ensure that management strategies are successful?

We present a new approach for managing wildlife species across multiple-use landscapes that takes advantage of current concepts, tools, and data bases. The five steps of the approach are described and illustrated with an example for a watershed in the Oregon Cascades.

Steps for Managing Wildlife Species

Step 1. Set Clear Objectives.

The term biodiversity is so all encompassing that management plans often have nebulous objectives such as maintaining "biodiversity," "ecosystem health," or "ecosystem sustainability." Whereas these may be suitable as broad goals, they are too general for building specific management prescriptions or for assessing whether the prescriptions are successful.

A biodiversity management plan should specify, at a minimum, response variables, target levels, and spatial/temporal domain. Response variables are the entities being managed. Both the organizational level(s) of interest (e.g., species, community, landscape) and the specific entities within each level need be clearly elucidated (e.g., species level: species requiring late-seral habitats). Target level specifies the relative or absolute abundance of the response variables that is considered sufficient.

Examples are maximizing diversity of native wildlife species, minimizing the number of species that fall below minimum viable population sizes, and maintaining even proportions of five specific seral stages. Spatial/temporal domain indicates the area and time period over which the target levels of the response variables are to be maintained (e.g., over at least 80 percent of the planning area for at least 100 years).

A 3,318 ha section of the Cook-Quentin watershed in the Willamette National Forest of the west Cascades of Oregon will serve as an example. We restrict our concern to vegetation and bird habitat patterns. The effects of factors such as topography, geomorphology, and hydrology are ignored in this demonstration. Land use patterns in the basin are typical of multiple-use federal forest lands in the region. Approximately 22 percent of the area has been clearcut under a staggered-setting design and reforested. The remaining area supports natural young, mature, and old-growth stands.

Based on the regional context of the planning area, objectives are established as follows:

1. Maximize across the planning area, in perpetuity, habitat diversity (Hill's N2) for bird species requiring late-seral (mature and old-growth) habitats and for those requiring structurally rich, open-canopy habitats.

2. Produce and harvest saw timber (trees>30 cm dbh) at levels compatible with Objective 1.

Step 2: Associate Target Species with Specific Habitat Configurations.

Detailed demographic data are generally only available for a few of the scores of wildlife species that may occupy a planning area. We suggest using habitat suitability as a surrogate for animal demography. The types of habitat factors known to be important to vertebrates include: vegetation structure, geomorphology, primary productivity, and climate. In locations where animal habitat associations are not well known, we suggest using the best available information. As little as we know about animal habitat associations, more is known than is generally used by managers. Ultimately, however, key field studies should be conducted to fill in knowledge gaps. Techniques for associating animals with habitat vary from simple seral-stage associations to complex statistical analyses of field data. Local data will dictate which techniques are appropriate.

We required for the Cook-Quentin application a means of assessing bird habitat relationships that (1) could be derived from existing studies, (2) considered habitat factors

at two or three spatial scales, and (3) could interface with the habitat simulation model chosen for the application.

We settled on a simple habitat classification scheme that considers just four variables: seral stage association, microhabitat association, response to edge, and minimum territory size. We identified 51 bird species likely to occur in the planning area based on a list of species having primary habitats in low- and mid-elevation conifer and conifer-hardwood forests in Oregon and Washington west of the Cascade Mountain crest.

Step 3: Assess the Potential Sensitivity of Species to Landscape Change.

How can managers know which of the several species in the planning are likely to be most vulnerable under management? The sensitivity of a species to landscape change may be predictable based on either its life-history traits or on the amount and distribution of suitable habitats.

Several studies have found that certain life-history traits are strongly correlated with proneness to extinction: low population size, short longevity, low reproductive rate, constrained dispersal, specialization on particular foods or habitats, and large home range size. The life-history traits of each species can be examined to determine which may be most sensitive to change.

One of the best predictors of species viability is simply the amount of suitable habitat. This can be determined by mapping vegetation, geomorphology, and other habitat features across the planning area and classifying habitat suitability based on the habitat associations of each species.

Current vegetation patterns in the Cook-Quentin drainage were derived from USDA Forest Service data bases. Habitat suitability across the basin was determined using a computer program that cross-tabulated the habitat requirements for each species with the characteristics of each 2.5-ha cell.

We found that less than 10 percent of the landscape in the Cook-Quentin drainage was suitable habitat for seven species. Most of these were birds that required open-canopy habitats. This is an example of the surprises that can occur when objective criteria are used to evaluate sensitive species.

Step 4: Project Future Habitat Patterns Under Alternative Management Prescriptions Using Simulation Models.

Land managers have a long history of trying to assess the likely future consequences of differing management strategies. Computer simulation models can be extremely useful for projecting the responses of several resource variables over long time periods and large areas. Such information allows managers to choose the management strategies that are most likely to accomplish the management objectives.

We used the landscape model LSPA and the gap model ZELIG.PNW to simulate one natural disturbance regime and three management alternatives in the Cook-Quentin drainage. LSPA is a simple geometric model that simulates changes in a gridded landscape of variable grain and extent. Designed to emulate the effects of timber harvest, the model modifies the state of the landscape at each time step according to a user-specified harvest regime involving cutting unit size, spatial distribution of cutting units, and harvest rate.

In order to track stand dynamics we additionally ran ZELIG.PNW for conditions typical of the Cook-Quentin drainage. ZELIG simulates the establishment, growth, and death of individual trees as a function of local environmental conditions. We have not yet fully validated ZELIG.PNW. Consequently, the results reported here should be viewed as preliminary.

Using both a landscape model and a gap model allowed us to track both landscape-level responses (e.g., seral stage distribution, landscape geometry, bird habitat suitability) and stand-level responses (e.g., standing basal area, harvested basal area).

The four disturbance/management regimes simulated are described in Table 1. Contact the authors for details on the models and methodology used here.

Table 1. Natural disturbance and management alternatives simulated for the Cook-Quentin drainage.

Model	Variable	Prescription			
		Natural Fire	Wood Production	Multi-Use Forestry	No Action
LSPA	Disturbance Patch Size (ha)	8.6[1]	22.5	40.0	NA
	Distribution Pattern	Random	Maximum Dispersal	Maximum Aggregation	NA
	Rotation Length (yrs)	114[2]	70	140	NA
	Minimum Harvest or Burn Age (yrs)	20	55	55	NA
ZELIG	Retention Level	9.8 PSME/ha	None	9.8 PSME/ha	NA
	Insetting (per ha)	Natural	988 PSME	484 PSME 484 TSHE	988 PSME
	Thinning Yrs 15 & 30 (per ha)	None	543 PSME	380 PSME 163 TSHE	None

[1] Patch Size is modeled as an exponential function with a mean of 8.6 ha.
[2] Fire rotation interval is an exponential function with a mean of 8.8% of the landscape per decade.

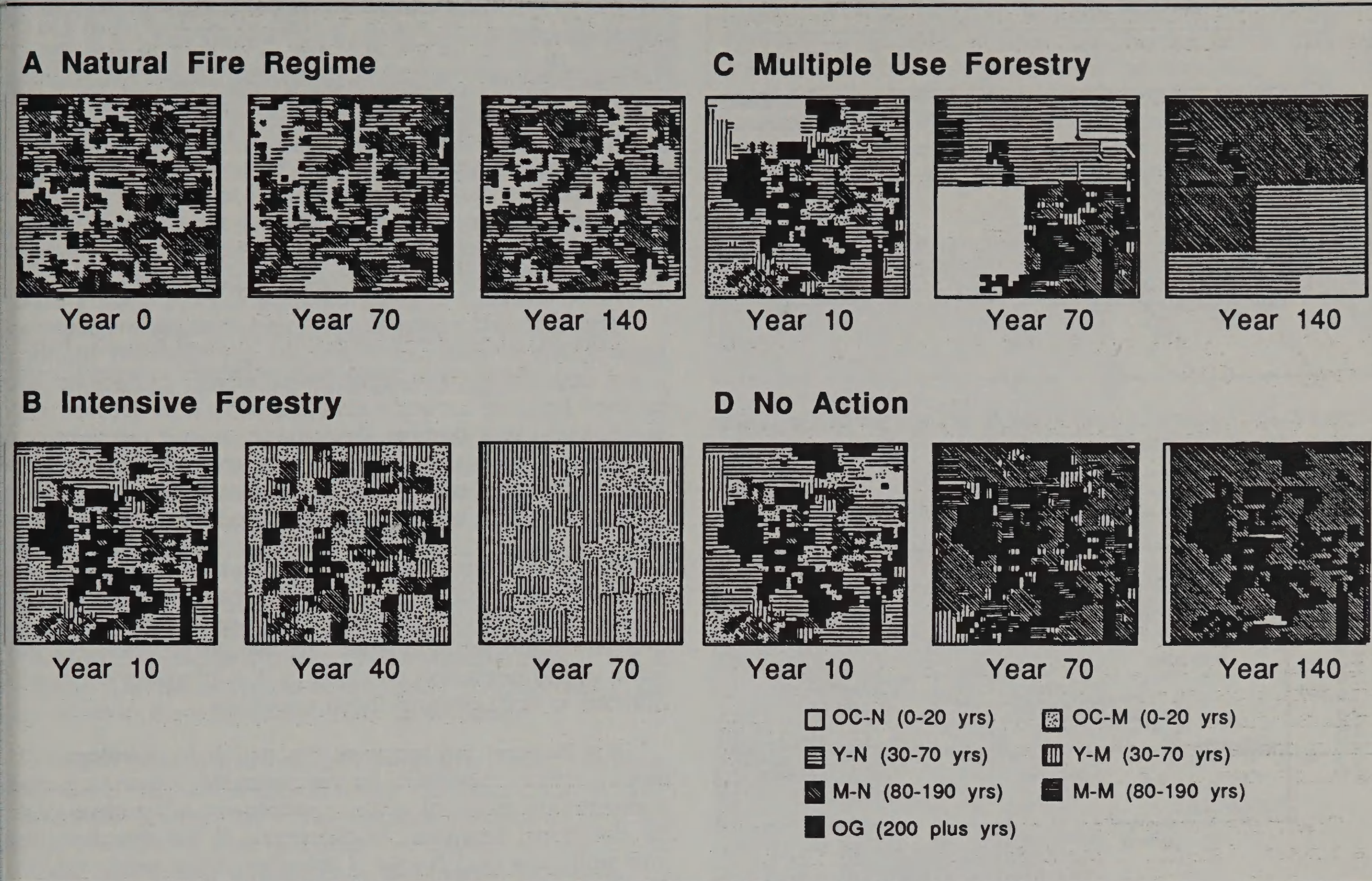

Figure 1. Maps of vegetation pattern in the Cook-Quentin planning area for selected time steps as simulated by the landscape model LSPA for four disturbance/management scenarios: (a) natural fire; (b) wood production; (c) multiple-use; and (d) no additional management intervention.

Simulated landscape patterns under each of the scenarios are depicted in Figure 1. Scenarios differed substantially in landscape pattern, wood production, and bird habitat suitability. For example, habitat diversity for all bird species was substantially lower under wood production than under the other three scenarios (Figure 2, Hill's N2), mostly because of the loss of natural microhabitats and late seral stages.

The multiple-use run produced habitat diversity similar to that under the natural fire scenario. This suggests that silvicultural methods are available for maintaining vertebrate habitat diversity in managed forests. Wood production, however, was substantially greater under the wood-production scenario than under multiple-use (Figure 3). This difference was due to (1) substantial reduction of modeled tree growth rates in the multiple-use prescription by overstory retention and mixed species planting, and (2) more rapid conversion of older, slower-growing natural stands to younger, faster-growing plantations under the wood production run.

This exercise is, to our knowledge, the first attempt to quantify the consequences for wildlife habitat and wood production of alternative management scenarios that considers both stand- and landscape-level factors.

Our models project rather dramatic differences in outputs among the four scenarios, a finding that should be of considerable interest to those forest managers debating the merits of alternative silvicultural strategies. We emphasize again, however, that neither the bird habitat models nor the ZELIG model have yet been sufficiently validated and the results should be considered preliminary.

Step 5: Implement a Preferred Strategy (or Strategies) and Monitor the Responses of Habitats and Species.

The cost/benefit analysis described above will aid in determining which management alternative is most likely to meet management objectives. Implementation of a preferred strategy (or strategies) is an experiment in itself that can reveal a great deal about resource response to manipulation. In fact, land managers may sometimes wish to subdivide the planning area and implement two or more management alternatives, in a replicated fashion if possible, and compare results.

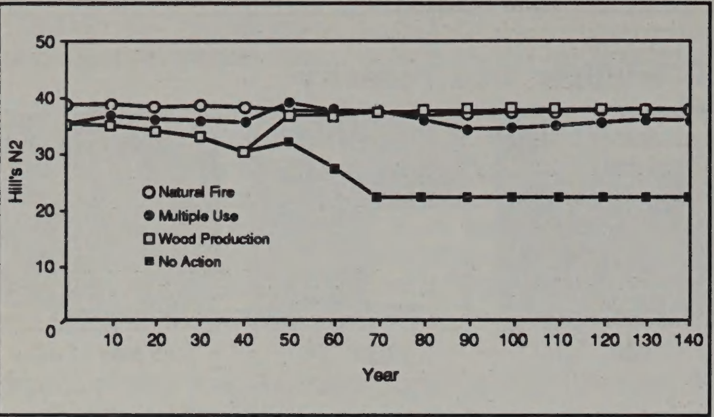

Figure 2. Bird habitat diversity in the planning area under the four management scenarios.

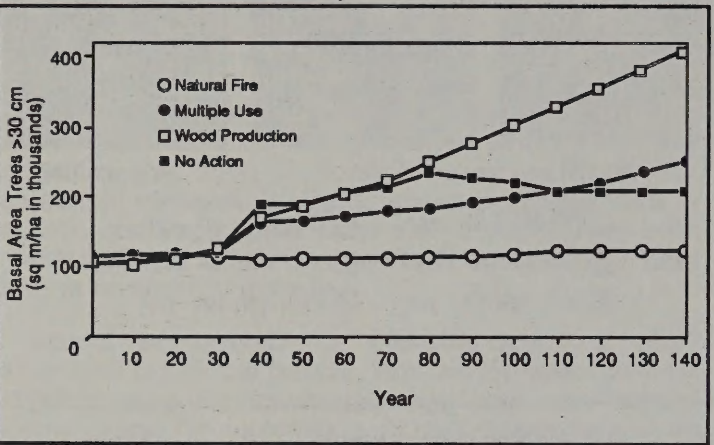

Figure 3. Wood production (cumulative basal area harvested up to each time step plus basal area of live trees) under each of the four scenarios.

A well-designed monitoring program is critical for learning from any management experiment. This view is widely held among federal forest managers. Most forest plans in our region call for some level of monitoring, but designing and implementing effective monitoring programs is neither simple nor inexpensive. This fact is in evidence in the Pacific Northwest where even the most basic information on habitat distributions in management units (e.g., snag levels in harvest units) has not been successfully assembled, much less the more comprehensive information needed to manage wildlife habitat diversity.

We suggest that managers of wildlife habitats monitor the effectiveness of implementing a prescription, the responses of habitat to the management action, and wildlife population responses.

Creative approaches are needed to collect these data in an efficient and cost-effective fashion. Remote sensing techniques offer great promise for sampling habitats from microsite to landscape and regional levels. Monitoring wildlife species abundance still requires sampling in the field. Ultimately inter-agency cooperation may offer the best hope of designing and implementing appropriate monitoring protocols.

The pay-offs of rigorous monitoring are apt to be considerable. These data are essential both for evaluating the extend to which management objectives were met and for testing and updating wildlife habitat and computer simulation models. Completion of Step 5 leads back to Step 1. An iteration process of reevaluating management objectives and conducting management experiments offers the best hope for successful resource management.

The trade-off analysis indicated that the multiple-use prescription is most likely to meet the specified management objectives. This prescription would appear to best provide habitats for early and late seral bird species while producing some timber. The cost in timber production of this alternative is substantial. On the other hand, the majority of early and late successional bird species would have no habitat under the wood production prescription.

If the multiple-use prescription were selected as the preferred alternative, many questions would remain on the consequence of different levels of retention, harvest unit sizes, and rotation ages. We would recommend that some experimentation be done as the alternative is implemented to help answer these questions.

It is beyond the scope of this paper to develop a rigorous monitoring protocol for the preliminary planning area. A monitoring program for the multiple-use alternative might be designed, however, to determine if the specified harvest unit sizes and levels of retention were achieved; the dynamics of the retained tree, snag, and CWD populations during the years and decades following implementation; and patterns of abundance of bird species in stands of different size and level of retention.

Conclusion

This approach for managing wildlife diversity has some important limitations. It deals only with wildlife species, a small subset of biodiversity. Many ecological processes are not directly considered, including energy flows and nutrient cycling, propagule dispersal, and the role of animals in altering habitats. Also, more thought needs to be given to the integration of this approach with models for other resources (e.g., fisheries, recreation, and water). Finally, the approach has not yet been fully field-tested. The example we offer is overly simplistic in objectives and the models used have not been validated.

We are presently modifying the models to make them more realistic and field testing the approach for watersheds in the Oregon Coast Range and Oregon Cascades in cooperation with Forest Service managers. We hope that this process will eventually provide managers with an approach that can improve the management of biological diversity.

Andy Hansen, Steve Garman, and Barbara Marks,
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WIND DAMAGE IN STREAMSIDE BUFFERS AND ITS EFFECT ON ACCELERATED SEDIMENTATION IN COASTAL OREGON STREAMS

Standing trees are left along fish-bearing streams after timber harvesting to ensure that fish habitat and water quality are not degraded. For state and private forest land, Oregon's Forest Practices Rules specify which streams require buffers and how many trees must be retained after harvesting. In 1987 the Forest Practice Rules were modified to increase the number of conifers that must be retained in buffers and the minimum width of required buffers. Some forest land managers question the windfirmness of wider buffers with more conifers and wonder how streams might be affected if many buffer trees blow down.

When trees in streamside buffers blow down, soil-laden root wads may enter the channel, uprooted trees on steep streamside slopes may cause shallow landslides, and, if a large number of trees fall into the stream, it may be rerouted, mobilizing streambank sediments. However, the actual wind damage to buffer trees and the subsequent effect on stream channels and sedimentation have never been evaluated. In this study, the extent of wind damage to streamside buffers in the northern half of the Oregon Coast Range was determined, along with the associated site and stand conditions and effects of wind damage on stream sediment levels and channel configuration.

Methods

Private timber companies and government agencies were contacted to help locate wind damaged streamside buffers along the central and northern Oregon coast. From all the prospective buffers, 30 1- to 6-year-old buffer strips were selected for study. The selected buffers occur along the Oregon coast between the Columbia and Siuslaw Rivers and inland about 20 miles in the north and 10 miles in the south (Figure 1). Most of the buffers met the minimum specifications of the current Forest Practice Rules and all buffers were in harvest units where both sides of the stream had been harvested and no subsequent salvage logging of downed trees had occurred.

For each study buffer, 1000 feet of stream was sampled. The high flow width, distance and slope from the streambank to the buffer edge, and the percent overstory canopy cover were measured at 100 foot intervals. All trees (standing, uprooted, or snapped off) greater than 6 inches dbh in the buffer were inventoried and damage caused by wind, logging, or slash burning was noted. For uprooted or snapped off trees, the direction of fall, distance from the stream, rooting depth of the upturned trees, and effect the tree had on the stream channel were recorded. Sources of sediment from wind damaged trees were recorded, and the amount of sediment that had entered or would enter the stream during the first 2 years following

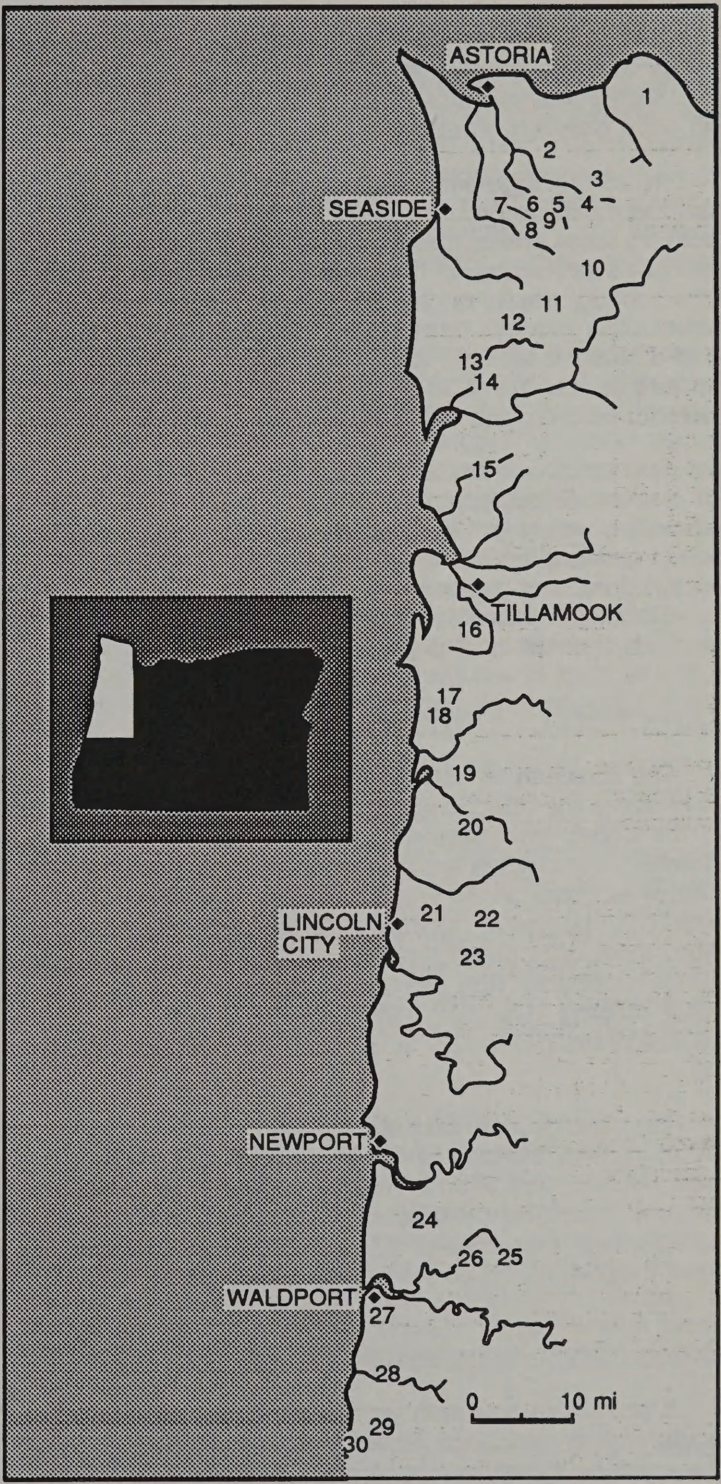

Figure 1. Location of study sites. Numbers indicate stream segments studied.

wind damage was visually estimated. All measurements were taken during the summers of 1988 and 1989.

Results

High wind was the most common cause of tree mortality within the study buffers; mortality from slash burning and logging damage were minor at most sites. The basal area of uprooted or snapped off trees ranged from 0 to 72 percent of the initial live tree basal area and wind damaged 20 percent or more of the initial live tree basal area at 13 sites. Narrow buffers did not appear more susceptible to wind damage than wide buffers.

Wind damage was often greater on terraces than on adjacent sloping ground; however, this was not true for all sites. In some cases, trees growing on the slope may have provided protection to the trees growing on the terraces. The rooting depth of the trees blown over was less on streamside terraces than on the adjacent sloping ground. The difference was greatest for hemlock; 73 percent had a rooting depth less than 2 feet on terraces, while only 24 percent had rooting depths less than 2 feet on slopes.

Species is also an indicator of potential wind damage in buffers. Sitka spruce was particularly susceptible to uprooting when growing on streamside terraces but not when growing on the adjacent sloping ground. Most uprooted spruce on terraces had a rooting depth of only 12 to 15 inches. Western hemlock was susceptible to windthrow on both terraces and sloping ground.

Direction of Damaging Winds

The direction of fall of wind-damaged trees was used to estimate the direction of high winds. The windward side of the buffer was assumed to be the side exposed to the direction from which winter storms typically approach, the southwest. Trees on the windward sides of buffers fell mostly within the northeast quadrant. Direction of fall for the leeward sides of buffers followed a fairly uniform distribution in the northeast and northwest quadrants. Presumably, wind passing over the buffer caused turbulence on the leeward side, producing in a more random pattern of tree fall.

The direction of damaging winds, determined from blowdown on the side of the buffer exposed to the southwest, ranged from S75E to N60W. At only 14 of 26 sites did the most common direction of tree fall indicate that damaging winds were indeed out of the southwest, which suggests that winds are locally rerouted by topography.

Predicting Amounts of Blowdown

A predictive equation was derived to assist managers in identifying situations where buffer blowdown is likely. The equation indicates that blowdown will be higher where more of the trees are growing on boggy terraces and where a greater percentage of the stand basal area consists of conifers. Blowdown will also be higher for buffers that are perpendicular to southwest winds and where local topography offers little protection from the southwest. The predictive equation for the sites in the study is:

$$\text{PERBLOW} = (-26.5) + 0.892\ (\text{BOGTER}) + 0.421\ (\text{CONIFER}) + 10.8\ (\text{ORIENT}) + 12.8\ (\text{SHAPE})$$

where

PERBLOW = Percentage of live tree basal area in the initial buffer stand uprooted or snapped off by wind.

BOGTER = Percentage of live trees in the initial buffer stand that grow on boggy terraces.

CONIFER = Percentage of basal area in the initial stand that is conifer.

ORIENT = Orientation of stream segment with respect to southwesterly winds (S45W). ORIENT = 0 if the stream flows northeast or southwest. ORIENT = 1 if the stream segment flows northwest or southeast.

SHAPE = Shape of the hillslope in a direction S30W or S60W from the midpoint of the stream segment. SHAPE = 0 if buffer receives protection from the surrounding terrain. SHAPE = 1 if buffer receives little protection from the surrounding terrain.

The degree of wind protection is evaluated by using a topographic map to plot elevation vs. distance for transects drawn from the stream segment midpoint. One transect is drawn at S30W and the other at S60W. Compare the plots of these transects with the diagrams in Figure 2 to determine whether the value for SHAPE should be 0 or 1. If one profile rates 0 and the other rates 1, then select 0 as the value to enter into the regression equation.

Remember that this equation applies only to the zone and the time period for which data was gathered. The equation would probably overestimate blowdown for streams further inland from the coast and underestimate it for periods that include an unusually severe wind storm like the Columbus Day storm of 1962.

Sedimentation and Channel Features

Only 58 percent of the uprooted or snapped off trees had any immediate or potential influence on the stream channel; the remainder rested on streamside slopes and terraces outside a vertical projection of the high water marks. Twelve percent of all downed trees were sources of accelerated erosion. Twenty-one percent of the trees that fell within the high water marks were sources of accelerated erosion. Increased erosion was almost always associated with overturned rootwads at the stream edge and sediment was most commonly released when high flows scoured the soil attached to the rootwads or the rootwad holes. In general, soil and rock from rootwads overturned upslope of streams with steeply sloping hillsides were not a sediment source to the stream. Rootwads only rarely moved downslope, and they physically blocked soil mov-

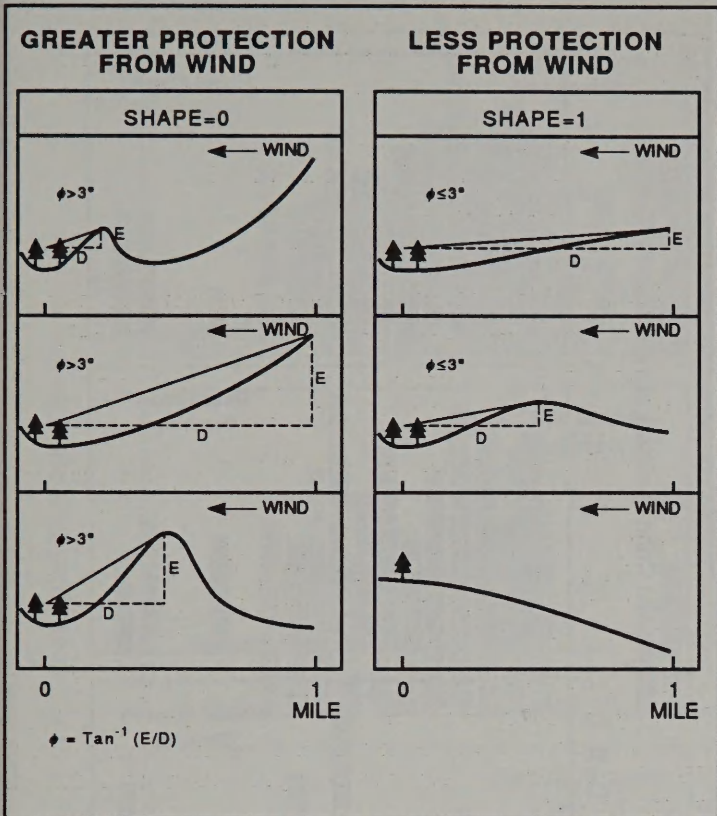

Figure 2. Determination of wind protection offered by terrain southwest of buffer.

ing down the slope from rootwad holes. The rootwad scars did not appear to be long-term sources of erosion or slope instability.

Sediment yield for each watershed prior to buffer wind damage was estimated and compared with the additional sediment estimated to result from the wind damage. Seven sites had estimated sediment yield increases greater than 1 percent. Two small streams with dense conifer stands growing close to the channel had significant wind damage that increased sediment 21 and 12 percent, respectively. Uprooted and snapped off trees within a buffer rarely caused major channel changes, because, even when blowdown was widespread, over one-third of the boles were suspended above the stream. Fewer than one-fifth of the trees that fell actually had their boles or tops in reach of high water.

Discussion

The mortality of trees in buffer strips and their subsequent entry into a stream channel has often been assumed to be gradual. This study shows that, for at least a portion of the Oregon Coast Range, tree mortality can be catastrophic the first few years following harvest. This study was limited to a narrow coastal zone during a time when severe winds did not occur. Few buffer strips with large amounts of conifers existed before 1983 and no severe wind storms have occurred since, so the extent of damage that severe winds could cause within contemporary buffer strips is not known. The results of this study probably underestimate damage by severe winds to buffers.

Large woody debris from wind-damaged buffers in the study area were not considered a threat to downstream culverts and bridges because the stems tended to remain in one piece after hitting the ground and the streams were not big enough to move whole trees with attached rootwads. For streams currently lacking adequate amounts of large woody debris, bucking the windthrown stems that remain suspended over the stream presents an opportunity to make some large woody debris immediately available.

Streamside slope stability, for the most part, remained uninfluenced by the windthrown trees. Progressive unravelling of slopes with uprooted trees did not occur in this study. Only uprooted trees that grew within or beside the stream channel were likely to become sediment sources. Trees that uprooted on slopes away from the stream remained in place and their rootwad holes were not sediment sources. Increases in sediment resulting from wind damage are probably not high enough to be detected anyway. However, on very small streams the additional soil added to the channel by numerous rootwads could be undesirable. Widespread wind damage to long stretches of buffer was not observed; most wind damage was patchy.

The regression equation developed for predicting blowdown indicated that damage would be greatest in buffers with a high conifer density, with many trees growing on streamside terraces that are perpendicular to southwest winds and have little downwind protection from terrain. However, this equation explained only 57 percent of the variation among the 30 sites. There is still much uncertainty in predicting "high risk" buffer strips and the decision to leave one should take downstream use, including domestic water supply and fish hatchery intakes, into consideration.

Wind damage in buffer strips often raises the question of salvaging the trees. In this study the upturned rootwads in or near the stream, not tree boles, were the primary source of accelerated erosion. Therefore, salvage logging is not likely to reduce sediment, in fact salvage logging may induce other rootwads to tumble into the stream thereby exacerbating short-term increases in sediment. Conversely, the rootwads are excellent large woody debris and could be beneficial by helping to form pools and other desirable channel features.

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Hank Froehlich,
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PATTERNS OF FISH COMMUNITIES IN THE ALSEA WATERSHED STUDY

The Alsea Watershed Study (AWS) was a 15-year project initiated in 1958 to investigate the impact of timber harvesting on aquatic habitat and fish populations. The AWS took place in three small headwater streams, Needle Branch, Deer Creek, and Flynn Creek, in the upper Drift Creek basin. Needle Branch, a 75 ha watershed, was clearcut with no bufferstrips along the stream. Deer Creek, a 304 ha watershed, was clearcut in approximately three 25 ha patches, and conifer bufferstrips were left along the streams. Flynn Creek, a 202 ha watershed, was not logged and served as the control. These three streams were studied 7 years prior to timber harvest, from 1958 to 1966, and then another 7 years after timber harvest, from 1966 to 1973. The AWS is one of the few long-term watershed studies of timber harvesting effects on aquatic habitat and fish populations. A major goal of the Fundamental COPE Fish Habitat Project is to resurvey Needle Branch, Deer Creek, and Flynn Creek annually to determine fish community status 25 years after timber harvest.

Alsea Watershed Comparison

Salmonid communities in these streams are dominated by juvenile coho salmon (*Oncorhynchus kisutch*) and coastal cutthroat trout (*Oncorhynchus clarki*). Juvenile coho populations and smolt numbers declined slightly after logging in all watersheds, though the decline was greatest in the forested control watershed. Mean biomass of juvenile coho was greater in the two logged watersheds and less in the control watershed in the post-logging period. Cutthroat trout abundance and biomass in Needle Branch declined during the post-logging period. Cutthroat trout abundances and biomass in Flynn Creek and Deer Creek were greater during the post-logging period than during the pre-logging period. Cutthroat abundance in Needle Branch remained low compared to pre-logging abundances even 10 years after logging.

Estimates of juvenile coho biomass in Flynn Creek during 1988 and 1989 were similar to the long-term average of 2.2 g/m^2. Coho biomass estimates in Deer Creek for 1988 and 1989 were low compared with the AWS data of 2.4 - 6.8 g/m^2. Coho biomass estimates in Needle Branch during 1989 were substantially greater than the AWS pre- and post-logging averages of 5.2 g/m^2.

Juvenile coho numbers in Flynn Creek during 1988 and 1989 were similar to the overall average of 1.00 coho per m^2. Juvenile coho densities in Deer Creek during 1988 and 1989 were within 0.61 - 1.78 coho per m^2, which was the range reported during the AWS; however, they were lower than the AWS pre- and post-logging averages. A juvenile coho density of 2.6 per m^2 in Needle Branch during 1989 was substantially greater than AWS pre- and post-logging averages by 98 percent and 128 percent, respectively. The data for juvenile coho densities is shown in Figure 1.

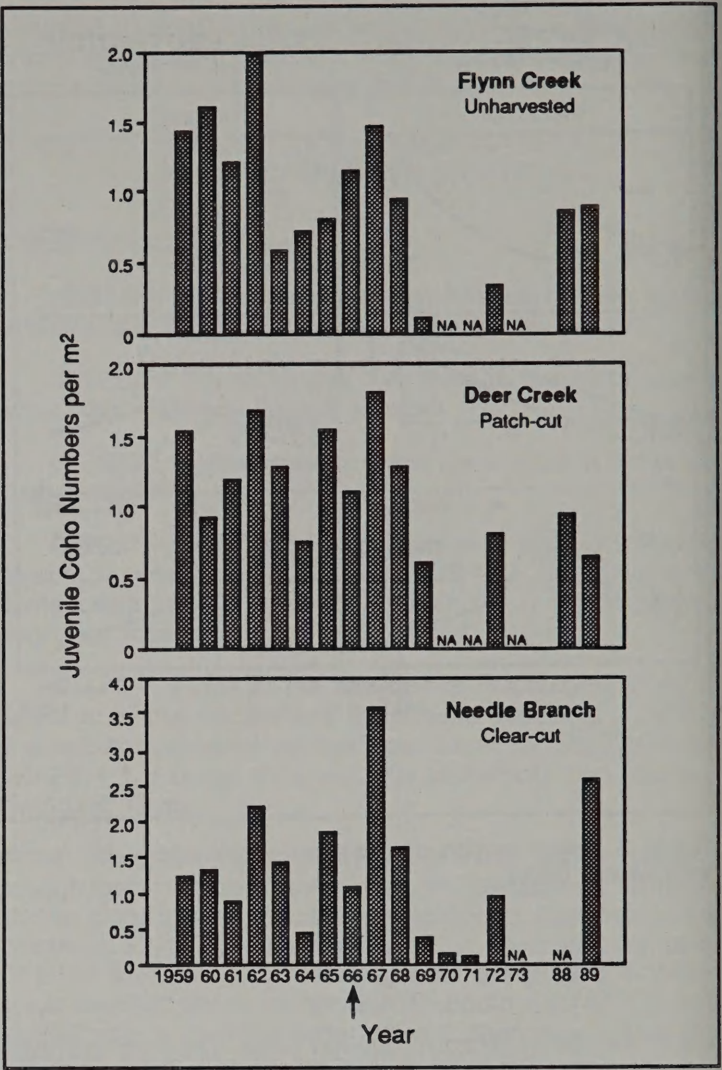

Figure 1. Densities of juvenile coho salmon for the Alsea Watershed Study streams. Arrow indicates year of logging.

In the original AWS, cutthroat trout populations declined in Needle Branch after clearcut logging without bufferstrips. Recent resurveys indicate potential long-term effects in 1988 and 1989. In Flynn Creek during 1988 and 1989, densities of cutthroat trout ranged from 0.2 to 0.38 per m^2 and biomass ranged from 2.7 to 5.8 g/m^2. Both of these values are within the range reported during the AWS. The long-term averages for cutthroat densities and biomass in Flynn Creek are 0.28 per m^2 and 3.7 g/m^2, which are similar to the 1988 and 1989 estimates. Cutthroat trout densities and biomass in Deer Creek during 1988 and 1989 were the lowest in all years surveyed indicating that cutthroat trout populations in Deer Creek have declined since the AWS. Cutthroat trout density in Needle Branch during 1989 was less than the AWS pre-logging value by half, but was greater than the post-logging value. Cutthroat trout biomass in Needle Branch during 1989 was less than the pre-logging and post-logging averages during the AWS. The data for cutthroat trout densities is shown in Figure 2.

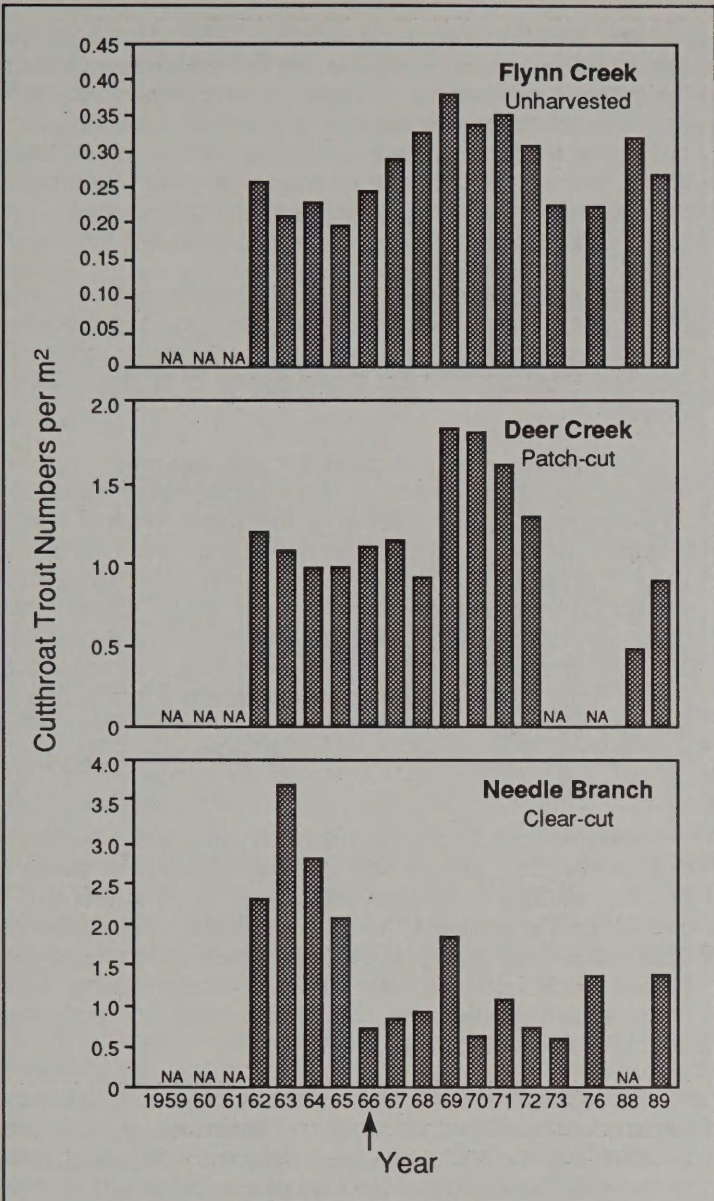

Figure 2. Densities of cutthroat trout for the Alsea Watershed Study streams. Arrow indicates year of logging.

Watershed Comparisons in Drift Creek Basin

Twenty-one streams in the Drift Creek Watershed were selected to represent unharvested forests, clearcuts with bufferstrips, and clearcuts without bufferstrips. The harvested sites had been logged 5 to 25 years before this study. Fish habitat and populations for these streams were inventoried during 1988 and 1989 and compared with the data from the AWS streams.

Stream width in the tributaries was not greater in the harvested units; however, clearcut sites were deeper than unharvested sites. Percent spawning gravel and fine sediment did not differ among land-use treatments. Volumes of large woody debris averaged 1.6 m^3 per 100 m^2 of stream surface for streams flowing through clearcuts without bufferstrips. These were less than for streams flowing through unharvested forests, which averaged 2.9 m^3 per 100 m^2 of stream surface.

Cutthroat trout densities, where juvenile coho co-occur, were lower in streams flowing through clearcuts without bufferstrips than in streams flowing through clearcuts with bufferstrips or unharvested forests. Juvenile coho densities (age 0+ trout fry, and juvenile coho) were positively correlated with large woody debris volumes in the active channels.

Discussion

Current fish populations in the AWS streams and similar streams in the Drift Creek basin show long-term, detrimental effects on cutthroat trout populations in streams flowing through clearcuts without bufferstrips. This pattern was also observed in large-scale inventories of salmonid distribution throughout the Drift Creek basin. In a survey of more than 50 miles of stream in the Drift Creek drainage, densities of cutthroat trout were lower in reaches associated with clearcuts. The densities and biomass of cutthroat trout in Needle Branch during 1989 were as low as the AWS post-logging estimates. Cutthroat trout density and biomass in Deer Creek during 1988 and 1989 had declined compared with the AWS data. On the basis of only 2 years of data, it is hard to tell if this is natural variation or a long-term trend. However, since cutthroat trout density and biomass in Flynn Creek during 1988 and 1989 did not change, it is possible that this data indicates cutthroat trout populations have declined in Deer Creek. Further study is warranted because timber harvest has continued in Deer Creek. During the AWS, about 25 percent of Deer Creek was harvested and, as of 1988, about 50 percent of the watershed had been harvested.

Cutthroat trout populations in Needle Branch have not recovered since harvesting occurred in 1966. Long-term declines in cutthroat trout density and biomass in these streams are associated with older age-class declines that, most likely, represent the resident cutthroat trout population. This response may be due to a lack of large woody debris and stream morphologic characteristics that favor juvenile coho. Large woody debris volumes in the active channels of the Drift Creek tributaries were lower in harvested sites without buffers than in those with buffers and in unharvested sites. Low cutthroat trout abundance in clearcut sites without buffers may be attributed to less available cover and loss of channel complexity due to less large woody debris. A potential response of salmonid communities to lower large woody debris volumes may be a shift in the partitioning of food resources between cutthroat trout and juvenile coho populations. Other potential responses include shifts in predation rates and lower over-winter survival during high stream flows.

Juvenile coho biomass and densities have shown no long-term shifts as a result of timber harvest beyond natu-

ral variation. In the AWS streams, they were more variable in the post-logging period than in the pre-logging period. Juvenile coho densities and biomass during 1989 in Needle Branch were high compared to the AWS years; however, they did not surpass 1967. Greater variability of fish abundance makes interpretation of land-use impacts difficult.

The Alsea Watershed Study provides a valuable long-term record of fish communities in the central Oregon coast and indicates that fishery response to land use may persist longer than anticipated. Juvenile coho numbers in streams flowing through harvested units may equal or exceed preharvest densities, but cutthroat trout population in streams flowing through harvest units without bufferstrips have exhibited prolonged declines. These patterns of fish response to land use observed by the Fundamental COPE Fish Habitat Research Project raise many important questions. If coho densities do not exhibit declines in harvested watersheds, why have returning adult coho numbers continued to decline? Cutthroat trout population reductions are apparently associated with large woody debris loss from the stream channels. Are such population declines persistent and widespread? Can current state and federal riparian zone management policies ensure an adequate future supply of large woody debris to streams? Whatever the answer to these questions, it is obvious that riparian management policies must be based on sound concepts of stream ecosystem structure and function.

Recommended Reading

Moring, J.R., and R.L. Lantz. 1975. The Alsea Watershed Study: Effects of logging on the aquatic resources of three headwater streams of the Alsea River, Oregon. Part I - Biological studies. OSFW Fishery Research Report No. 9, Corvallis, Oregon. 66 p.

Schwartz, J.S. 1991. Influence of geomorphology and land use on distribution and abundance of salmonids in a coastal Oregon basin. M.S. Thesis, Oregon State University, Corvallis. 207 p.

Stan Gregory and John Schwartz,
OSU Fisheries and Wildlife Department

OF INTEREST

CLIMBING TREES TO LOOK FOR MAPLE SEEDLINGS

When was the last time that you donned tree climbing gear to look for tree seedlings? Crazy, you say! Final proof that fundamental COPE researchers have a few cards short of a full deck! Not really.

The weather this year (and in 1988) has been such that germination of bigleaf maple seeds still dangling from the tree has been quite common. We have no quantitative estimates of the percentage of seeds produced that germinate prior to dispersal (referred to as vivipary in botanical lingo), but in late January as many as 25 to 50 percent of the seeds remaining on some trees had germinated (Figure 1), as evidenced by the presence of exposed radicles.

How does this come about? We briefly describe below what seems to be happening (based partly on observations we presented in a paper in the Western Journal of Applied Forestry and on those made over the past few years).

As maple seeds mature in the late summer, their moisture content drops steadily, reaching a minimum of 10 to 20 percent prior to the onset of fall rains. When collected at this time, seeds appear to have reached a maximum level of dormancy; in order to stimulate germination, they should be stratified for 60 to 90 days at 33^0 to 35^0F. With the onset of fall rains, seed moisture content increases to 35 to 45 percent; embryo moisture content remains fairly stable while the moisture in the pericarp surrounding the embryo fluctuates with weather conditions. (We believe that the hairy outer pericarp helps the seed soak up and retain water.)

Seed dispersal can begin at anytime after September or October and some trees disperse all of their seeds by December. Timing of dispersal seems to be influenced by genetic and environmental factors. That is, some trees shed their seeds early every year while others retain large numbers of seeds well into February and March. Rainy, windy weather accelerates the rate of dispersal for both early and late dispersing trees.

Seeds retained on trees apparently have their dormancy requirements fulfilled as early as December. Maple seeds become active at low temperatures as evidenced by their germination after 90 to 120 days of incubation at stratification temperatures of 33^0 to 35^0F. Once dormancy require-

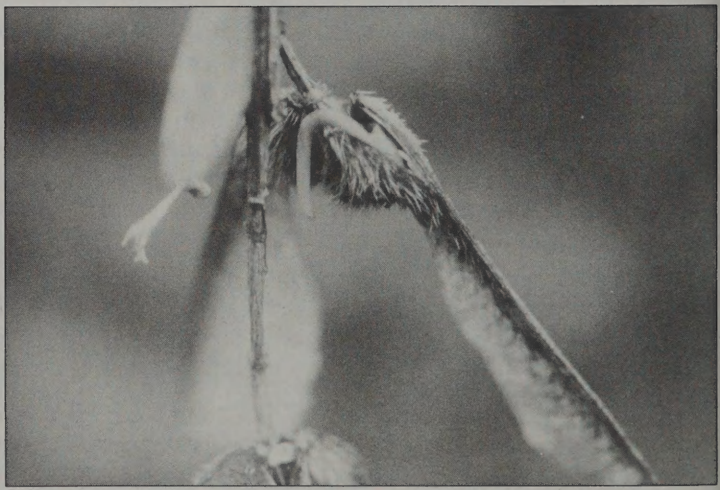

Figure 1. Germinating bigleaf maple seed still attached to the tree. The exposed root is about 1 inch long.

ments are fulfilled, seeds begin to germinate on the tree—the higher the air temperature, the more rapidly germination will progress. Individual seeds may have different requirements for dormancy and germination, and there may be a lot of variation (Figure 2) among seeds on a tree.

The occurrence of vivipary in trees in our part of the world is not common. It does not occur in vine maple which is often present with bigleaf maple. "Viney" has very different germination requirements, and usually seeds germinate over 2 to 3 years even under optimum conditions. Vivipary has been observed in tropical trees and in some members of the white oak group in the southern United States.

One can speculate regarding the value of this germination strategy to successful regeneration of bigleaf maple. There appear to be two general options available to the species—shed seeds as soon as possible and have dormancy requirements fulfilled while on the forest floor, or germinate while suspended in mid-air and hope that the germinated seeds find a good spot to become established once they are dispersed. Both options come with some risks. Seeds dispersed prior to germination (this seems to be the most common situation) are prized by small mammals, and many are eaten before or shortly after germination on the forest floor. We find that bigleaf maple seeds purposely sown on the forest floor disappear quickly and produce few seedlings unless protected. If seeds stay on the tree and germinate, the probability of making a meal for a rodent is reduced. But the risk of being dispersed to a bad spot or having the germinating seed dry out and die before the seed is dispersed is high.

The Oregon Coast Range provides a hospitable environment for the growth of trees and other plants as indicated by the high levels of productivity. This relatively receptive environment also allows some unique and interesting patterns of plant development, as we believe is exemplified by the germination of bigleaf maple seeds high above the soil surface. Understanding these developmental patterns helps us to understand and appreciate the diversity around us and to take advantage of these growth patterns when designing silvicultural alternatives.

Figure 2. Four seeds removed from tree to show variation in radicle development.

John Zasada,
USDA Forest Service

OPPORTUNITIES

ESTATE PLANNING

June 11-12, 1992 — Portland, OR
June 15-16, 1992 — Ashland, OR

This course is designed for forest landowners, forestry consultants, extension foresters, and other natural resource professionals who work with timber owners. It would also be of benefit to accountants, attorneys, trust officers, and estate planners who wish to gain a better knowledge of how the unique characteristics of timber assets relate to the federal estate and gift tax law and estate planning.

This course will provide participants with a working knowledge of federal estate and gift tax and an overview of state death tax considerations applicable to timberland in their estates. The implications of recent tax law changes for accumulating and protecting forestry assets will be discussed. Strategies for intergenerational transfer of timberland will be emphasized. The course focuses on each major area of estate and gift tax law and estate planning that affects timber assets. Examples will be used to illustrate various estate planning strategies and procedures applicable for forest properties. Ample time will be provided for discussion, including a review of recent court decisions, IRS regulations and administrative rulings concerning forest estates.

Sponsors include Oregon State University, OSU Extension Forestry, and the Society of American Foresters. For more information contact the Conference Assistant, College of Forestry, OSU, 202 Peavy Hall, Corvallis, OR 97331-5707 or phone (503) 737-2329.

PACIFIC YEW: A RESOURCE FOR CANCER TREATMENT

August 3-5, 1992 — Corvallis, OR

This conference will be of interest to natural resource managers, researchers, health professionals, interest groups, and all citizens concerned about Pacific yew. and taxol production.

The 2-day conference (August 3 and 4) includes both general and technical sessions designed to increase understanding of the issues and to promote interaction by participants of diverse backgrounds. A 1-day optional field trip (August 5) will provide a chance to view Pacific yew in wild and managed stands and to observe bark harvesting, handling procedures, and other management practices.

Along with interpretive displays and exhibits, this conference promises to provide a forum for sharing information and encouraging dialogue about research, management, conservation, and social issues concerning the role of Pacific yew and the production of taxol in treating cancer.

It is co-sponsored by the USDI Bureau of Land Management, USDA Forest Service, Pacific Northwest Research Station, OSU College of Forestry, and the National Cancer Institute. For more information contact the Conference Assistant, College of Forestry, OSU, 202 Peavy Hall, Corvallis, OR 97331-5707 or phone (503) 737-2329.

STAND INVENTORY TECHNOLOGIES

September 13-17, 1992
World Forestry Center,Portland, OR

SIT '92 will be a "how-to" conference for resource managers specializing in range, wildlife, watershed and forestry. It will provide a forum for demonstrating and discussing the use of stand inventory technologies from around the world. Methodologies and systems will be presented that are being used to collect, process and report natural resource information to users.

Sampling designs will be reviewed involving mapped polygons of vegetation either as inventory units or as sampling units within more extensive surveys. There will be displays and training with the latest equipment associated with stand inventory analysis.

Sponsors are the International Union of Forestry Research Organizations, World Forest Institute, USDA Forest Service Tropical Forestry Program and Western Forestry and Conservation Association. For more information contact the World Forestry Center, 4033 SW Canyon Road, Portland, OR 97221 or phone (503) 228-0803.

GENETIC CONSIDERATIONS OF BIODIVERSITY IN PACIFIC NORTHWEST FORESTS

September 23-24, 1992 Corvallis, OR

This workshop will emphasize the role of genetic diversity in the survival and productivity of forest tree species in the Pacific Northwest and the impacts of forest management on this diversity. Concepts of genetics—including the basis of genetic diversity, its measurement, patterns of natural variation, evolutionary mechanisms, and the significance of genetics in biodiversity issues—will be reviewed. Genetic implications of alternative silviculture systems and tree improvement practices will also be addressed, as well as strategies and methods of gene conservation. Group discussions will help clarify gene resource issues facing forest managers and identify needs for future research and policy resolution.

This workshop is intended for foresters, wildlife biologists and other forest resource specialists, as well as managers. It is co-sponsored by the College of Forestry, Oregon State University, and the Western Forest Genetics Association. For more information contact the Conference Assistant, College of Forestry, OSU, 202 Peavy Hall, Corvallis, OR 97331-5707 or phone (503) 737-2329.

RECENT PUBLICATIONS

IDENTIFYING TREES IN RIPARIAN AREAS THAT CAN PROVIDE COARSE WOODY DEBRIS TO STREAMS by E.G. Robison and R.L. Beschta. 1990. Forest Science 36(3):790-801. Coarse woody debris (CWD) can enhance or improve fish habitat by affecting channel morphology and sedimentation. Forest practice rules in some Pacific Northwest states call for recruitment of CWD into streams. However, under current rules, conifers that are likely to provide wood to streams may be cut, whereas conifers that are not likely to add wood to streams may be left. The authors present geometrical and empirical equations for (1) determining the conditional probability that individual trees will provide CWD to streams, and (2) relating the probability to the basal area factor measured in the field. A practical example of the method is presented for Douglas-fir of various sizes with a range of probabilities. With this information, ground personnel can use prisms or wedges to identify specific trees that are likely to provide CWD to streams.

JS

MODELING INPUTS OF LARGE WOODY DEBRIS TO STREAMS FROM FALLING TREES by J. Van Sickle and S.V. Gregory. 1990. Canadian Journal of Forest Research 20(10):1593-1601. A probabilistic model was developed that predicts the means and variances of total number and volume of large woody debris that falls into a stream. Only bolewood falling directly into the stream is modeled. Branches, treetops, downslope movement, or downstream movement by floating, debris avalanches, or torrents are not considered. Model input is the riparian stand density by species, height, and distance from the stream. Input of

debris to the stream is computed from the probability of tree fall based on stand mortality rates and a probability density function for the angle of tree fall. The angle of tree fall can be either totally random, with an equal probability of falling in any direction, or biased toward falling toward the stream channel.

The output of the model was compared with observed data from Mack Creek in H.J. Andrews Experimental Forest. Predicted distributions of woody debris volume and orientation were similar to those in Mack Creek, but observed and predicted distributions of piece length differed markedly because of the lack of a breakage function for falling trees. Predicted relationships between riparian management zone width and relative woody debris input were carried out to demonstrate some of the potential uses of the model in riparian zone management. The model allows the consequences of alternative management practices, such as different numbers and sizes of harvested trees and different riparian zone widths, to be explored.

AES

CONSERVING BIODIVERSITY IN MANAGED FORESTS by A.J. Hansen, T.A. Spies, F.J. Swanson, and J.L. Ohmann. BioScience 41(6):382-392. 1991. This paper compares natural and managed forests across a range of ages in terms of vegetation structure and diversity of plants and animals. All age classes of natural forest were found to share some of the structural features that were previously thought to be unique to old growth. This similarity in structure is thought to explain the finding that most vascular plants and vertebrates studied thus far do not differ significantly in abundance among natural young, mature, and old-growth forests. Plantations managed under traditional practices, in contrast, often lack the structural complexity typical of all stages of natural forest. Consequently, animal communities are often less diverse in plantations than in natural stands. Natural and managed forests also may differ in landscape patterns in ways that influence species diversity. The management implications of this study are that managed stands and landscapes can be designed to maintain or create some of the desirable attributes of natural forests. Studies of the various costs and benefits of such alternative management designs are needed. Until such methods are better tested, managers striving to maintain species diversity should consider retaining representative tracts of natural forests of all ages.

AJH

GENETIC EFFECTS OF CULTURED FISH ON NATURAL FISH POPULATIONS by K. Hindar, N. Ryman, and F. Utter. 1991. Canadian Journal of Fisheries and Aquatic Sciences 48:945-957. Wild salmon stocks of the Pacific Northwest are currently in a period of rapid decline. This decline may be attributed to: loss of freshwater habitat, poor ocean conditions, overharvesting, and the introduction of non-native stocks.

This paper addresses the genetic consequences of aquaculture on natural fish populations. It reviews the empirical observations of intentional and accidental releases. Where genetic effects on performance traits have been documented, they always appear negative in comparison with unaffected native populations. These findings raise concerns over the genetic future of many natural populations in the light of increasing numbers of released fish. The authors recommend strategies for the genetic protection of native populations as well as strong restrictions on gene flow from cultured to wild populations.

DB

COPE Report

READER SURVEY

To better understand what our readers would like to see in this newsletter, we have developed the following questionnaire. Please circle the rating that represents your objective judgment. Additional comments and suggestions would be appreciated. The completed survey can be folded in half, taped or stapled, and mailed postage-paid to the Adaptive COPE office.

Your Job Title: ______________________________

The State and County you live in: ______________________________

State County

Technical Evaluation

How do you rate the technical quality of the COPE Report articles?

Poor Fair Satisfactory Good Excellent

What is your opinion of the mix of disciplines offered? (i.e., fisheries/wildlife/silviculture/hydrology/soils)

Poor Fair Satisfactory Good Excellent

What percentage of the information presented is useful?

0-20% 21-40% 41-60% 61-80% 81-100%

Format Evaluation

How do you rank the use of illustrations and tables?

Poor Fair Satisfactory Good Excellent

How do you rank the importance of photographs in the newsletter?

Poor Fair Satisfactory Good Excellent

Is there a specific edition (or article) of the COPE Report which you particularly liked or did not like? Please explain.

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What would you like to see more of in the COPE Report?

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Additional comments and suggestions:

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